The Perovskite Database

Instructions for formatting and entering data into the database

Document version 5.4

Data template

The latest version of the data template is found at: www.perovskitedatabase.com
The data template is used for writing data into the database, and it specifies the formatting conventions. With time higher level routines will be written that build on top of the template and simplify data entry, but for now, using this data template is the simplest way to get data into the database.

Concerning data for tandem cells

This data template is made for single junction cells. If you have data for tandem cells, there is a separate template for that.

General instructions

This document describes all fields in the data template and how to fill them in correctly. When reporting data, please adhere to the following guidelines.

One cell per column

The database uses the individual solar cell as the basic organisational unit. Every entry should represent data for one specific cell. For example, if EQE was measured on one cell, stability under illumination on another cell, and stability in the dark on a third cell, this data should be split into three different entries as the data comes from three individual cells.

A left to right, and a substrate first paradigm

When defining the stack sequence for a cell, start with the substrate to the left. For any subsequent layer (e.g. substrate, electron transport layer, perovskite, hole transport layer, back contact, etc.) write the material closest to the substrate to the left, and the material furthest from the substrate to the right.

The data should be interpreted by a machine.

Remember that the data should be read and interpreted by a machine. Thus, pay good attention to the formatting guidelines as if you do not, your data may become a distraction, a source of confusion, or rendered invisible.

The row names in the data template are used as the keys to the data while reading in and processing the data. Do not change them.

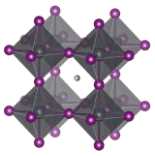
- Changing the name of a row (or the spelling), make that row invisible while the data is written to the database as row names are used as data keys.
- Removing a row (because you never use it) is ok. Default values will be inserted automatically.
- Adding an extra row (to capture more parameters or for private comments while entering data) is ok, but that data will be ignored when data is written to the data base.

All data is better than some data, but some data is better than no data.

The ambition is to get as much data as possible for every perovskite device ever made. With that said, getting part of a dataset is much more valuable to the community than getting nothing.

When entering numbers, use plain numbers, refrain from scientific notation, and ignore uncertainties.

- Use plain numbers and not scientific notation, e.g. write 1000000 and not 1E6. Scientific notation is not yet implemented.



- For values with uncertainties, state the best estimate, e.g. write 80 and not 70-90. Routines for handling uncertainties are not yet implemented.

Categorical data

For fields with categorical data, i.e. solvents, chemicals, light sources, etc. data validation with dropdown menus is in place. Data can be written into those field, but if the text is not in the dropdown menu, an error message will show. If you have done something not covered by the given alternatives, simply add a new category in the table specified by the error message. Categories not used in your lab can be removed from the tables of alternatives to simplify data entry. If data is copied into the cells, the data validation routines is overwritten. Thus, if you copy data, make sure it really is properly formatted.

Grammar of the database, i.e. the specific meaning of different delimiters

The vertical bar, i.e. (' | ')

If a field contains data for more than one layer, separate the data belonging to the different layers by a vertical bar with a space on both sides, i.e. (' | ')
Layers should be sorted left to right with the substrate first, i.e. to the left.

The semicolon. i.e. ('; ')

If several materials, solvents, gases, etc. are occurring in one layer or during one reaction step, e.g. A and B, list them in alphabetic order and separate them with semicolons, as in (A; B)

The double forward angel bracket, i.e. (' >> ')

When a layer in a stack is deposited, it may be more than one reaction step involved. If that is the case, separate the information concerning the different reaction steps, e.g. A, and B, by a double forward angel bracket with one blank space on both sides, as in ('A >> B') to represent 'A then B'.

The decimal point, i.e. (' . ')

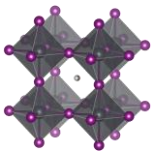
When entering numbers, use decimal points and not decimal commas.

Alphabetic ordering of lists

When several elements of information are connected to one layer or to one reaction step, the elements should be ordered in alphabetic order. This greatly simplifies downstream data processing. The exception to that principle is when a list is describing another list that is sorted in alphabetic order, e.g. a solution contains the three components A, B, and C whereas another field specifies the concentrations for A, B, and C. In that field, the order of the concentrations must line up with components. Otherwise, it will be hard to interpret which concentration is are linked to which component.

Abbreviations

-np	nano particles
-mp	mesoporous
-QDs	quantum dots
-SWCNTs	single wall carbon nano tube
-MWCNTs	multi wall carbon nano tube
-nt	nano tube
-nr	nano rod
ALD	Atomic vapour deposition
CVD	Chemical vapour deposition
CBD	Chemical bath deposition
-IO	invers opal
-c	compact

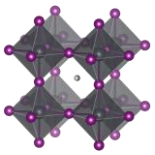


Descriptions of the columns in the database

There are 394 columns in the data extraction protocol. Everything will not be known for every cell but if you have done the cell yourself, you will be able to fill in most of the data in most of the categories. Below is a description for how to fill in and format every single filed. There is a lot of repetition in the instruction, but that also means that you do not need to read everything if you have questions about one specific field.

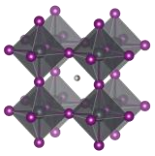
The columns are grouped into 15 topics

- Reference information
- Cell definition
- Module definition (for modules only)
- Substrate
- Electron transport layer
- The perovskite layer
- The perovskite deposition
- The hole transport layer
- The back contact
- Additional layers, e.g. encapsulation, antireflective coatings, etc.
- JV data
- Stabilised efficiencies
- Quantum efficiency
- Stability
- Outdoor testing

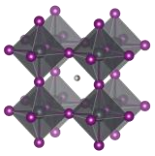


Contents

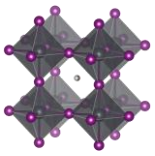
The Perovskite Database 1
Instructions for formatting and entering data into the database 1
Document version 5.3 1
Data template 1
Concerning data for tandem cells 1
General instructions 1
One cell per column 1
A left to right, and a substrate first paradigm 1
The data should be interpreted by a machine. 1
The row names in the data template is used as the keys to the data while reading in and processing the data. Do not change them. 1
All data is better than some data, but some data is better than no data. 1
When entering numbers, use plane numbers, refrain from scientific notation, and ignore uncertainties. 1
Categorical data 2
Grammar of the database, i.e. the specific meaning of different delimiters 2
Abberivations ..... **Error! Bookmark not defined.**
Descriptions of the columns in the database 3
Reference information 15
Ref. ID temp (Integer starting from 1 and counting upwards) 15
Ref. Name of person entering the data 15
Ref. Data entered by author [TRUE/FALSE] 15
Ref. DOI number 15
Ref. Lead author 15
Ref. Publication date [year:mm:dd] 15
Ref. Free text comment (max 280 characters) 15
Ref. Internal sample ID [free text] 15
Cell definition 16
Cell. Stack sequence [Mat.1; Mat.2; ... | Mat.3; ... | Mat.4 | ...] 16
Cell. Area. Total [cm^2] 16
Cell. Area. Measured [cm^2] 16
Cell. Number of cells per substrate 17
Cell. Architecture [nip/pin/ …] 17
Cell. Flexible [TRUE/FALSE] 17
Cell. Flexible. Minimum bending radius [cm] 17
Cell. Semitransparent [TRUE/FALSE] 17
Cell. Semitransparent. Average visible trasmittance [%] 17
Cell. Semitransparent. Average visible transmittance. Wavelength range [lambda_min; lambda_max] 17
Module definition 18
Module [TRUE/FALSE] 18
Module. Number of cells in module 18
Module. Area. Total [cm^2] 18



Module. Area. Effective [cm^2] 18
Module. JV data recalculated per cell [TRUE/FALSE] 18
Substrate 19
Substrate. Stack sequence [Mat.1; Mat.2; ... | Mat.3; ... | Mat.4 | ...] 19
Substrate. Thickness [Th.1 | Th.2 | … | Th.n] [mm] 19
Substrate. Area [cm^2] 19
Substrate. Supplier 19
Substrate. Brand name 20
Substrate. Deposition procedure [Proc. 1 >> Proc. 2 >> ... | Proc. 3 >> … | Proc. 4 | ...] 20
Substrate. Surface roughness. Rms [nm] 20
Substrate. Etching procedure 20
Substrate. Cleaning procedure 21
Electron transport layer 22
ETL. Stack sequence [Mat.1; Mat.2; ... | Mat.3; ... | Mat.4 | ...] 22
ETL. Thickness [Th.1 | Th.2 | … | Th.n] [nm] 22
ETL. Additives. Compounds [Addt.1; Addt.2; ... | Addt.3; … | Addt.4 | ...] 23
ETL. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; ... | c4 mg/ml | ...] 23
ETL. Deposition. Procedure [Proc. 1 >> Proc. 2 >> ... | Proc. 3 >> … | Proc. 4 | ...] 23
ETL. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> ... | Agr. 3 >> … | Agr. 4 | ...] 24
ETL. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 24
ETL. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> ... | P.3 >> … | P.4 | ...] [atm/Torr/Pa/bar/mmHg] 25
ETL. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> ... | P.4 >> … | P.5 | ...] [atm/Torr/Pa/bar/mmHg] 25
ETL. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> ... | RH3 >> … | RH4 | ...] [%] 25
ETL. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; ... >> ... | Sol.4 >> … | Sol.5 | ...] 26
ETL. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> ... | V5; V6 >> … | 1 | ...] 26
ETL. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 27
ETL. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 27
ETL. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | ...] 27
ETL. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 28
ETL. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 28
ETL. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> ... | c4 wt%; c5 vol% | c6 ppm |...] 29
ETL. Deposition. Reaction solutions. Volumes [V1 >> V2 >> ... | V3 >> … | V4 | ...] [ml] 29
ETL. Deposition. Reaction solutions. Age [A1 >> A2 >> ... | A3 >> … | A4 | ...] [h] 30
ETL. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 30
ETL. Deposition. Substrate. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 30
ETL. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 31
ETL. Deposition. Thermal annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> … | t5 | ...] [min] 31



ETL. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 31
ETL. Storage. Time until next deposition step [h] 32
ETL. Storage. Atmosphere [Gas1; Gas2; ...] 32
ETL. Storage. Relative humidity [%] 32
ETL. Surface treatment before next deposition step 32
The perovskite 34
Perovskite. Single crystal [TRUE/FALSE] 34
Perovskite. Dimension. 0D (Quantum dot) [TRUE/FALSE] 34
Perovskite. Dimension. 2D [TRUE/FALSE] 34
Perovskite. Dimension. 2D/3D mixture [TRUE/FALSE] 34
Perovskite. Dimension. 3D [TRUE/FALSE] 34
Perovskite. Dimension. 3D with 2D capping layer [TRUE/FALSE] 34
Perovskite. Dimension. List of layers [Dim.1 | Dim.2 | …] 34
Perovskite. Composition. Perovskite ABC3 structure [TRUE/FALSE] 34
Perovskite. Composition. Perovskite inspired structure [TRUE/FALSE] 35
Perovskite. Composition. A-ions [Ion.1; Ion.2; … | Ion.3; … | ...] 35
Perovskite. Composition. A-ions. Coefficients [Cof.1; Cof.2; … | Cof.3; … | ...] 35
Perovskite. Composition. B-ions [Ion.1; Ion.2; … | Ion.3; … | ...] 36
Perovskite. Composition. B-ions. Coefficients [Cof.1; Cof.2; … | Cof.3; … | ...] 36
Perovskite. Composition. C-ions [Ion.1; Ion.2; … | Ion.3; … | ...] 36
Perovskite. Composition. C-ions. Coefficients [Cof.1; Cof.2; … | Cof.3; … | ...] 37
Perovskite. Composition. None-stoichiometry. Components in excess [Com.1; Com.2; … | Com.3; … | ...] .37
Perovskite. Composition. Short form (A-ions B-ions C-ions. Each in alphabetic order) 37
Perovskite. Composition. Long form (PLEASE FOLLOW INSTRUCTIONS!) 37
Perovskite. Composition. Assumption [Solution composition/Experimental verification/Literature/ …] 38
Perovskite. Composition. Inorganic perovskite [TRUE/FALSE] 38
Perovskite. Composition. Lead free [TRUE/FALSE] 38
Perovskite. Additives. Compounds [Addt.1; Addt.2; ... | Addt.3; … | Addt.4 | ...] 38
Perovskite. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; ... | c4 mg/ml | ...] 38
Perovskite. Thickness [Th.1 | Th.2 | … | Th.n] [nm] 39
Perovskite. Band gap [Eg.1 | Eg.2 | ...] [eV] 39
Perovskite. Band gap. Graded [TRUE/FALSE | TRUE/FALSE | ...] 40
Perovskite. Band gap. Estimation basis [Absorption/Composition/Literature/EQE/…] 40
Perovskite. Pl max [PL.1; PL.2; … | PL.3; … | ...] [nm] 40
Perovskite deposition 41
Perovskite. Deposition. Number of deposition steps 41
Perovskite. Deposition. Procedure [Proc. 1 >> Proc. 2 >> ... | Proc. 3 >> … | Proc. 4 | ...] 41
Perovskite. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> ... | Agr. 3 >> … | Agr. 4 | ...] 43
Perovskite. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 43
Perovskite. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> ... | P.3 >> … | P.4 | ...] [atm/Torr/Pa/bar/mmHg] 44



Perovskite. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> ... | P.4 >> … | P.5 | ...] [atm/Torr/Pa/bar/mmHg] 44

Perovskite. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> ... | RH3 >> … | RH4 | ...] [%] 44

Perovskite. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; ... >> ... | Sol.4 >> … | Sol.5 | ...] 45

Perovskite. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> ... | V5; V6 >> … | 1 | ...] 45

Perovskite. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 45

Perovskite. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 46

Perovskite. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | ...] 46

Perovskite. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 47

Perovskite. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 47

Perovskite. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> ... | c4 wt%; c5 vol% | c6 ppm |...] 47

Perovskite. Deposition. Reaction solutions. Volumes [V1 >> V2 >> ... | V3 >> … | V4 | ...] [ml] 48

Perovskite. Deposition. Reaction solutions. Age [A1 >> A2 >> ... | A3 >> … | A4 | ...] [h] 48

Perovskite. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 49

Perovskite. Deposition. Substrate. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 49

Perovskite. Deposition. Quenching induced crystallisation [TRUE/FALSE] 49

Perovskite. Deposition. Quenching media [Sol.1; Sol.2; …] 49

Perovskite. Deposition. Quenching media. Mixing ratios [V1; V2: ...] 50

Perovskite. Deposition. Quenching media. Volume [µl] 50

Perovskite. Deposition. Quenching media. Additives. Compounds [Addt.1; Addt.2; ...] 50

Perovskite. Deposition. Quenching media. Additives. Concentrations [c1 M; c2 wt%; c3 mg/ml; ...] 50

Perovskite. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 51

Perovskite. Deposition. Thermal annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> … | t5 | ...] [min] 51

Perovskite. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 51

Perovskite. Deposition. Thermal annealing. Relative humidity [RH1 >> RH2 >> ... | RH3 >> … | RH4 | ...] [%] 52

Perovskite. Deposition. Thermal annealing. Pressure [P.1 >> P.2 >> ... | P.3 >> … | P.4 | ...] [atm/Torr/Pa/bar/mmHg] 52

Perovskite. Deposition. Solvent annealing [TRUE/FALSE] 53

Perovskite. Deposition. Solvent annealing. Time vs thermal annealing [Before/Under/After/...] 53

Perovskite. Deposition. Solvent annealing. Solvent atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 53

Perovskite. Deposition. Solvent annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> … | t5 | ...] [min] 53

Perovskite. Deposition. Solvent annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 53

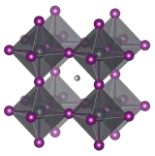
Perovskite. Deposition. After treatment of formed perovskite 53

Perovskite. Deposition. After treatment of formed perovskite. Metrics 54

Perovskite. Storage. Time until next deposition step [h] 54

Perovskite. Storage. Atmosphere [Gas1; Gas2; ...] 54

Perovskite. Storage. Relative humidity [%] 54



Perovskite. Surface treatment before next deposition step 54

Hole transport layer 56

HTL. Stack sequence [Mat.1; Mat.2; ... | Mat.3; ... | Mat.4 | ...] 56

HTL. Thickness [Th.1 | Th.2 | … | Th.n] [nm] 56

HTL. Additives. Compounds [Addt.1; Addt.2; ... | Addt.3; … | Addt.4 | ...] 56

HTL. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; ... | c4 mg/ml | ...] 57

HTL. Deposition. Procedure [Proc. 1 >> Proc. 2 >> ... | Proc. 3 >> … | Proc. 4 | ...] 57

HTL. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 58

HTL. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> ... | Agr. 3 >> … | Agr. 4 | ...] 58

HTL. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> ... | P.3 >> … | P.4 | ...] [atm/Torr/Pa/bar/mmHg] 58

HTL. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> ... | P.4 >> … | P.5 | ...] [atm/Torr/Pa/bar/mmHg] 59

HTL. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> ... | RH3 >> … | RH4 | ...] [%] 59

HTL. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; ... >> ... | Sol.4 >> … | Sol.5 | ...] 59

HTL. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> ... | V5; V6 >> … | 1 | ...] 60

HTL. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 60

HTL. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 61

HTL. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | ...] 61

HTL. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 62

HTL. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 62

HTL. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> ... | c4 wt%; c5 vol% | c6 ppm |...] 63

HTL. Deposition. Reaction solutions. Volumes [V1 >> V2 >> ... | V3 >> … | V4 | ...] [ml] 63

HTL. Deposition. Reaction solutions. Age [A1 >> A2 >> ... | A3 >> … | A4 | ...] [h] 63

HTL. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 64

HTL. Deposition. Substrate. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 64

HTL. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 64

HTL. Deposition. Thermal annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> … | t5 | ...] [min] 65

HTL. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 65

HTL. Storage. Time until next deposition step [h] 66

HTL. Storage. Atmosphere [Gas1; Gas2; ...] 66

HTL. Storage. Relative humidity [%] 66

HTL. Surface treatment before next deposition step 66

Back contact 67

Backcontact. Stack sequence [Mat.1; Mat.2; ... | Mat.3; ... | Mat.4 | ...] 67

Backcontact. Thickness. List [Th.1 | Th.2 | … | Th.n] [nm] 67

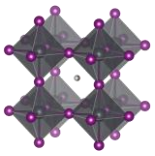
Backcontact. Additives. Compounds [Addt.1; Addt.2; ... | Addt.3; … | Addt.4 | ...] 67

Backcontact. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; ... | c4 mg/ml | ...] 68

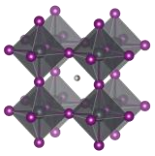
Backcontact. Deposition. Procedure [Proc. 1 >> Proc. 2 >> ... | Proc. 3 >> … | Proc. 4 | ...] 68

Backcontact. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> ... | Agr. 3 >> … | Agr. 4 | ...] 69
Backcontact. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] .69
Backcontact. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> ... | P.3 >> … | P.4 | ...] [atm/Torr/Pa/bar/mmHg] 70
Backcontact. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> ... | P.4 >> … | P.5 | ...] [atm/Torr/Pa/bar/mmHg] 70
Backcontact. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> ... | RH3 >> … | RH4 | ...] [%] 70
Backcontact. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; ... >> ... | Sol.4 >> … | Sol.5 | ...] 71
Backcontact. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> ... | V5; V6 >> … | 1 | ...] 71
Backcontact. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 72
Backcontact. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 72
Backcontact. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | ...] 72
Backcontact. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 73
Backcontact. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 73
Backcontact. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> ... | c4 wt%; c5 vol% | c6 ppm |...] 74
Backcontact. Deposition. Reaction solutions. Volumes [V1 >> V2 >> ... | V3 >> … | V4 | ...] [ml] 74
Backcontact. Deposition. Reaction solutions. Age [A1 >> A2 >> ... | A3 >> … | A4 | ...] [h] 75
Backcontact. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 75
Backcontact. Deposition. Substrate. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 75
Backcontact. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 76
Backcontact. Deposition. Thermal annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> … | t5 | ...] [min] 76
Backcontact. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 76
Backcontact. Storage. Time until next deposition step [h] 77
Backcontact. Storage. Atmosphere [Gas1; Gas2; ...] 77
Backcontact. Storage. Relative humidity [%] 77
Backcontact. Surface treatment before next deposition step 77
Additional layers, e.g. encapsulation, antireflective coatings, etc. 79
Add. Lay. Frontside. [TRUE/FALSE] 79
Add. Lay. Frontside. Function [A.R.C./Upconversion/Down conversion/Back reflection/ ...] 79
Add. Lay. Frontside. Stack sequence [Mat.1; Mat.2; ... | Mat.3; ... | Mat.4 | ...] 79
Add. Lay. Frontside. Thickness. List [Th.1 | Th.2 | … | Th.n] [nm] 79
Add. Lay. Frontside. Additives. Compounds [Addt.1; Addt.2; ... | Addt.3; … | Addt.4 | ...] 80
Add. lay. Fronside. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; ... | c4 mg/ml | ...] 80
Add. Lay. Frontside. Deposition. Procedure [Proc. 1 >> Proc. 2 >> ... | Proc. 3 >> … | Proc. 4 | ...] 80
Add. lay. Fronside. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> ... | Agr. 3 >> … | Agr. 4 | ...] 81
Add. lay. Fronside. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 81

Add. lay. Fronside. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> ... | P.3 >> … | P.4 | ...] [atm/Torr/Pa/bar/mmHg] 82
Add. lay. Fronside. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> ... | P.4 >> … | P.5 | ...] [atm/Torr/Pa/bar/mmHg] 82
Add. lay. Fronside. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> ... | RH3 >> … | RH4 | ...] [%] 82
Add. lay. Fronside. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; ... >> ... | Sol.4 >> … | Sol.5 | ...] 83
Add. lay. Fronside. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> ... | V5; V6 >> … | 1 | ...] .83
Add. lay. Fronside. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 83
Add. lay. Fronside. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 84
Add. lay. Fronside. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | ...] 84
Add. lay. Fronside. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> … | Sup.5 | ...] 85
Add. lay. Fronside. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; ... >> ... | Pur.4 >> … | Pur.5 | ...] 85
Add. lay. Fronside. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> ... | c4 wt%; c5 vol% | c6 ppm |...] 86
Add. lay. Fronside. Deposition. Reaction solutions. Volumes [V1 >> V2 >> ... | V3 >> … | V4 | ...] [ml] ..86
Add. lay. Fronside. Deposition. Reaction solutions. Age [A1 >> A2 >> ... | A3 >> … | A4 | ...] [h] 87
Add. lay. Fronside. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 87
Add. lay. Fronside. Deposition. Substrate. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 87
Add. lay. Fronside. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> … | T5 | ...] [deg. C] 88
Add. lay. Fronside. Deposition. Thermal annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> … | t5 | ...] [min] ..88
Add. lay. Fronside. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> … | Gas5 | ...] 88
Add. lay. Fronside. Storage. Time until next deposition step [h] 89
Add. lay. Fronside. Storage. Atmosphere [Gas1; Gas2; ...] 89
Add. lay. Fronside. Storage. Relative humidity [%] 89
Add. lay. Fronside. Surface treatment before next deposition step 89
Additional layers. Backcontact side 91
Encapsulation [TRUE/FALSE] 91
Encapsulation. Stack sequence [Mat.1; Mat.2; ... | Mat.3; ... | Mat.4 | ...] 91
Encapsulation. Edge sealing materials [Mat.1; Mat.2; ...] 91
Encapsulation. Atmosphere for encapsulation [Gas1; Gas2; ...] 91
Encapsulation. Water vapour transmission rate [g/m^2/d] 92
Encapsulation. Oxygen transmission rate [cm^3/m^2/d] 92
JV data 93
JV. Measured [TRUE/FALSE] 93
JV. Average over N number of cells 93
JV. Certified values [TRUE/FALSE] 93
JV. Certification Institute 93



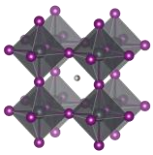
JV. Storage. Age of cell [days] 93
JV. Storage. Atmosphere [Gas1; Gas2; ...] 93
JV. Storage. Relative humidity [%] 94
JV. Test. Atmosphere [Gas1; Gas2; ...] 94
JV. Test. Relative humidity [%] 94
JV. Test. Temperature [deg. C] 94
JV. Light source. Type [Dark/White LED/Metal halide/ ...] 95
JV. Light source. Brand name 95
JV. Light source. Simulator class 95
JV. Light. Intensity [mW/cm^2] 95
JV. Light. Spectra [AM 1.5/UVA/UVB/Monochromatic/ …] 96
JV. Light. Wavelength range [lambda min; lambda max] or [lambda constant] [nm] 96
JV. Light. Illumination direction [Substrate/superstrate] 96
JV. Light. Masked cell [TRUE/FALSE] 96
JV. Light. Mask area [cm^2] 96
JV. Scan. Speed [mV/s] 96
JV. Scan. Delay time [ms] 97
JV. Scan. Integration time [ms] 97
JV. Scan. Voltage step [mV] 97
JV. Preconditioning. Protocol [none/Light soaking/Potential biasing/ …] 97
JV. Preconditioning. Time [s] 97
JV. Preconditioning. Potential [V] 97
JV. Preconditioning. Light intensity [mW/cm^2] 98
JV. Reverse scan. Voc [V] 98
JV. Reverse scan. Jsc [mA/cm^2] 98
JV. Reverse scan. FF [number between 0 and 1] 98
JV. Reverse scan. PCE [%] 98
JV. Reverse scan. Vmp [V] 98
JV. Reverse scan. Jmp [mA/cm^2] 99
JV. Reverse scan. Series resistance [ohmcm^2] 99
JV. Reverse scan. Shunt resistance [ohmcm^2] 99
JV. Forward scan. Voc [V] 99
JV. Forward scan. Jsc [mA/cm^2] 99
JV. Forward scan. FF [number between 0 and 1] 99
JV. Forward scan. PCE [%] 99
JV. Forward scan. Vmp [V] 100
JV. Forward scan. Jmp [mA/cm^2] 100
JV. Forward scan. Series resistance [ohmcm^2] 100
JV. Forward scan. Shunt resistance [ohmcm^2] 100
JV. Link. Raw data 100
Stabilised efficiencies 101
Stabilised performance. Measured [TRUE/FALSE] 101
Stabilised performance. Procedure [MPPT/Constant potential/Constant current/ …] 101



Stabilised performance. Procedure. Metrics [Potential in V, Current in mA/cm^2, ...] 101
Stabilised performance. Measurement time [min] 101
Stabilised performance. PCE [%] 101
Stabilised performance. Vmp [V] 101
Stabilised performance. Jmp [mA/cm^2] 101
Stabilised performance. Link. Raw data 102
Quantum efficiency 102
EQE. Measured [TRUE/FALSE] 102
EQE. Light bias [mW/cm^2] 102
EQE. Integrated Jsc [mA/cm^2] 102
EQE. Link. Raw data 102
Stability 103
Stability. Measured [TRUE/FALSE] 103
Stability. Protocol [ISOS x/IEC x/ …] 103
Stability. Average over N number of cells 103
Stability. Light source. Type [Dark/White LED/Metal halide/ ...] 103
Stability. Light. Intensity [mW/cm^2] 104
Stability. Light. Spectra [AM 1.5/UVA/UVB/Monochromatic/ …] 104
Stability. Light. Wavelength range [lambda min; lambda max] or [lambda constant] [nm] 104
Stability. Light. Illumination direction [Substrate/superstrate] 104
Stability. Light. Load condition [Continious/Cycled/Day-nigh/ …] 104
Stability. Light. Cycling times [time in low light; time in high light] [h] 105
Stability. Light. UV filter [TRUE/FALSE] 105
Stability. Potential bias. Load condition [Open circuit/MPPT/Constant potential/ …] 105
Stability. Potential bias. Range [U.min; U.max] or [U.constant] [V] 105
Stability. Potential bias. Passive resistance [ohm] 106
Stability. Temperature. Load condition [Constant/Uncontrolled/Cycled/ ...] 106
Stability. Temperature. Range [T.min; T.max] or [T.constant] [deg. C] 106
Stability. Temperature. Cycling times [t at T.min; t at T.max] [h] 106
Stability. Temperature. Ramp speed [deg. C/min] 107
Stability. Atmosphere [Gas1; Gas2; ...] 107
Stability. Atmosphere. Oxygen concentration [%] 107
Stability. Relative humidity. Load conditions [Ambient/Controlled/Cycled/ …] 107
Stability. Relative humidity. Range [RH.min; RH.max] [%] 108
Stability. Relative humidity. Average value [%] 108
Stability. Time. Total exposure [h] 108
Stability. Periodic JV measurements [TRUE/FALSE] 108
Stability. Periodic JV measurements. Time between measurements [h] 108
Stability. PCE. Initial value [%] 108
Stability. PCE. Burn in observed [TRUE/FALSE] 108
Stability. PCE. End of experiment [% of initial PCE] 109
Stability. PCE. T95 [h] 109
Stability. PCE. Ts95 [h] 109

Stability. PCE. T80 [h] 109
Stability. PCE. Ts80 [h] 109
Stability. PCE. Te80 [h] 109
Stability. PCE. Tse80 [h] 110
Stability. PCE. After 1000 h [% of initial PCE] 110
Stability. Lifetime energy yield [kWh/m^2] 110
Stability. Flexible cell. Number of bending cycles 110
Stability. Flexible cell. Bending radius [degrees] 110
Stability. Flexible cell. PCE. Initial value [%] 110
Stability. Flexible cell. PCE. End of experiment [% of initial PCE] 110
Stability. Link. Raw data for stability trace 111
Outdoor testing 112
Outdoor. Tested [TRUE/FALSE] 112
Outdoor. Protocol [ISOS x/IEC x/ …] 112
Outdoor. Average over N number of cells 112
Outdoor. Location. Country [Country] 112
Outdoor. Location. City [City] 112
Outdoor. Location. Coordinates [Latitude; Longitude] [decimal degrees] 112
Outdoor. Location. Climate zone [Tropical/Subtropical/Temperate/Cold] 113
Outdoor. Installation. Tilt [degrees] 113
Outdoor. Installation. Cardinal direction [degrees] 113
Outdoor. Installation. Number of solar tracking axis [0/1/2] 113
Outdoor. Time. Season [Winter/Summer/ …] 113
Outdoor. Time. Start [year:mm:dd:hh:mm] 114
Outdoor. Time. End [year:mm:dd:hh:mm] 114
Outdoor. Time. Total exposure [days] 114
Outdoor. Potential bias. Load condition [Open circuit/MPPT/Constant potential/ …] 114
Outdoor. Potential bias. Range [U.min; U.max] or [U.constant] [V] 114
Outdoor. Potential bias. Passive resistance [ohm] 114
Outdoor. Temperature. Load condition [Constant/Uncontrolled/Cycled/ ...] 115
Outdoor. Temperature. Range [T.min; T.max] or [T.constant] [deg. C] 115
Outdoor. Temperature. Tmodule [degrees C] 115
Outdoor. Periodic JV measurements [TRUE/FALSE] 115
Outdoor. Periodic JV measurements. Time between measurements [h] 115
Outdoor. PCE. Initial value [%] 115
Outdoor. PCE. Burn in observed [TRUE/FALSE] 116
Outdoor. PCE. End of experiment [% of initial PCE] 116
Outdoor. PCE. T95 [h] 116
Outdoor. PCE. Ts95 [h] 116
Outdoor. PCE. T80 [h] 116
Outdoor. PCE. Ts80 [h] 116
Outdoor. PCE. Te80 [h] 116
Outdoor. PCE. Tse80 [h] 117

Outdoor. PCE. After 1000 h [% of initial PCE] 117
Outdoor. Power generated [kWh/year/m^2] 117
Outdoor. Link. Raw data for outdoor trace 117
Outdoor. Detaild weather data available [TRUE/FALSE] 117
Outdoor. Link. Detailed weather data 117
Outdoor. Spectral data available [TRUE/FALSE] 118
Outdoor. Link. Spectral data 118
Outdoor. Irradiance measured [TRUE/FALSE] 118
Outdoor. Link. Irradiance data 118



Reference information

Ref. ID temp (Integer starting from 1 and counting upwards)

Format: Integer
Description: A temporary reference number to keep track of the devices before they are submitted to the database. Start with 1 and count upwards. Will be replaced with a unique identifier when written to the database.

Ref. Name of person entering the data

Format: Text string
Default: Empty string
Description: Your name.

Ref. Data entered by author [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if you how enter the data also was involved in making the device or if you are a co-author of the paper where the data is presented.

Ref. DOI number

Format: Text string
Default: Empty string
Description: The DOI number referring to the published paper or dataset where the data can be found. If the data is unpublished, enter "Unpublished"
Examples:

10.1021/jp5126624
10.1016/j.electacta.2017.06.032
Unpublished

Ref. Lead author

Format: Text string
Default: Empty string
Description: The surname of the first author. If several authors, end with et al. If the DOI number is given correctly, this will be extracted automatically from www.crossref.org

Ref. Publication date [year:mm:dd]

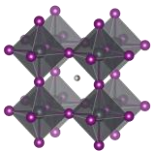
Format: Date
Default: Empty string
Format: Year:mm:dd
Description: Publication date. If the DOI number is given correctly, this will be extracted automatically from www.crossref.org

Ref. Free text comment (max 280 characters)

Format: Text string
Default: Empty string
Description: This could be anything given additional description to the cell that is not captured by any other field.

Ref. Internal sample ID [free text]

Format: Text string
Default: Empty string
Description: This is your own unique cell identifier. With this text string alone, you should be able to identify this cell in your own internal data management system.



Cell definition

Cell. Stack sequence [Mat.1; Mat.2; … | Mat.3; … | Mat.4 | …]

Format: Text string
Default: "Unknown"
Description: The stack sequence describing the cell. Use the following formatting guidelines

- Start with the substrate to the left and list the materials in each layer of the device
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If two materials, e.g. A and B, are mixed in one layer, list the materials in alphabetic order and separate them with semicolons, as in (A; B)
- The perovskite layer is stated as "Perovskite", regardless of composition, mixtures, dimensionality etc. There are plenty of other fields specifically targeting the perovskite.
- If a material is doped, or have an additive, state the pure material here and specify the doping in the columns specifically targeting the doping of those layers.
- There is no sharp well-defined boundary between a when a material is best considered as doped to when it is best considered as a mixture of two materials. When in doubt if your material is doped or a mixture, use the notation that best capture the metaphysical essence of the situation
- Use common abbreviations when possible but spell it out when there is risk for confusion. For consistency, please pay attention to the abbreviation specified under the headline Abbreviations found earlier in this document.
- There are several thousand stack sequences described in the literature. Try to find your one in the list of alternatives in the data template. If it is not there (i.e. you may have done something new) define a new stack sequence according to the instructions.

Example: Below are the 16 most common device stacks which represent close to half of all reported devices.

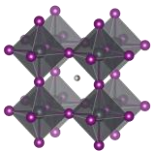
SLG | FTO | TiO2-c | TiO2-mp | Perovskite | Spiro-MeOTAD | Au
SLG | FTO | TiO2-c | Perovskite | Spiro-MeOTAD | Au
SLG | FTO | TiO2-c | TiO2-mp | Perovskite | Spiro-MeOTAD | Ag
SLG | FTO | TiO2-c | Perovskite | Spiro-MeOTAD | Ag
SLG | ITO | PEDOT:PSS | Perovskite | PCBM-60 | Al
SLG | ITO | PEDOT:PSS | Perovskite | PCBM-60 | BCP | Ag
SLG | ITO | PEDOT:PSS | Perovskite | PCBM-60 | Ag
SLG | FTO | TiO2-c | TiO2-mp | Perovskite | Carbon
SLG | FTO | TiO2-c | TiO2-mp | ZrO2-mp | Perovskite | Carbon
SLG | FTO | SnO2-c | Perovskite | Spiro-MeOTAD | Au
SLG | ITO | SnO2-np | Perovskite | Spiro-MeOTAD | Au
SLG | ITO | PEDOT:PSS | Perovskite | C60 | BCP | Ag
SLG | ITO | TiO2-c | Perovskite | Spiro-MeOTAD | Au
SLG | FTO | TiO2-c | TiO2-mp | Perovskite | PTAA | Au
SLG | FTO | SnO2-np | Perovskite | Spiro-MeOTAD | Au
SLG | ITO | NiO-c | Perovskite | PCBM-60 | BCP | Ag

Cell. Area. Total [cm^2]

Format: Float
Default: nan
Description: The total cell area in cm^2. The total area is defined as the area that would provide photovoltaic performance when illuminated without any shading, i.e. in practice the geometric overlap between the top and bottom contact.

Cell. Area. Measured [cm^2]

Format: Float
Default: nan



Description: The effective area of the cell during IV and stability measurements under illumination. If measured with a mask, this corresponds to the area of the hole in the mask. Otherwise this area is the same as the total cell area.

Cell. Number of cells per substrate

Format: Integer
Default: 0
Description: The number of individual solar cells, or pixels, on the substrate on which the reported cell is made

Cell. Architecture [nip/pin/ …]

Format: Text string
Default: "Unknown"
Description: The cell architecture with respect to the direction of current flow and the order in which layers are deposited. The two most common are nip (also referred to as normal) and pin (also referred to as inverted) but there are also a few others, e.g. Back contacted

- nip architecture means that the electrons are collected at the substrate side. The typical example is when a TiO_2 electron selective contact is deposited between the perovskite and the substrate (e.g. SLG | FTO | TiO2-c |Perovskite | …)
- pin architecture means that it instead is the holes that are collected at the substrate side. The typical example is when a PEDOT:PSS hole selective contact is deposited between the perovskite and the substrate (e.g. SLG | FTO | PEDOT:PSS |Perovskite | …)

Cell. Flexible [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell flexible and bendable.

Cell. Flexible. Minimum bending radius [cm]

Format: Float
Default: nan
Description: The minimum bending radius possible without degrading the cells performance

Cell. Semitransparent [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell is semi-transparent, which usually is the case when there are no thick completely covering metal electrodes.

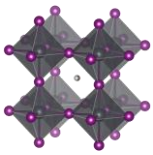
Cell. Semitransparent. Average visible trasmittance [%]

Format: Float
Default: nan
Description: The average visible transmittance in the wavelength range stated in the next field

Cell. Semitransparent. Average visible transmittance. Wavelength range [lambda_min; lambda_max]

Format: text string
Default: none
Description: the wavelength range under which the average visible transmittance is determined
Example:

400; 720
350; 770



Module definition

Module [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell is a module composed of connected individual sub cells

Module. Number of cells in module

Format: Integer
Default: 0
Description: The number of cells in the module

Module. Area. Total [cm^2]

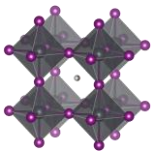
Format: Float
Default: nan
Description: The total area of the module in cm^2. This includes scribes, contacts, boundaries, etc. and represent the module's geometrical footprint.

Module. Area. Effective [cm^2]

Format: Float
Default: nan
Description: The active area of the module in cm^2.

Module. JV data recalculated per cell [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: The preferred way to report IV data for modules is to recalculate the IV data to average data per sub-cells in the module. That simplifies downstream comparisons, and it ensures that there is no erroneous transformation that otherwise may occur when error checking the IV data. Mark this as TRUE if the conversation is done.



Substrate

Substrate. Stack sequence [Mat.1; Mat.2; … | Mat.3; … | Mat.4 | …]

Format: Text string
Default: "Unknown"
Description: The stack sequence describing the substrate.

- With the substrate, we refer to any layer below the electron transport layer in a nip-device, and any layer below the hole transport layer in a pin-device.
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If two materials, e.g. A and B, are mixed in one layer, list the materials in alphabetic order and separate them with semicolons, as in (A; B)
- Use common abbreviations when appropriate but spell it out if risk for confusion.
- There are a lot of stack sequences described in the literature. Try to find your one in the list. If it is not there (i.e. you may have done something new) define a new stack sequence according to the instructions.

Example: Below are some of the most common substrates

SLG | FTO
SLG | ITO
PET | ITO
PEN | ITO
SLG | AZO
PET | IZO

Substrate. Thickness [Th.1 | Th.2 | … | Th.n] [mm]

Format: Text string
Default: nan
Description: A list of thicknesses of the individual layers in the stack. Use the following guidelines

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- The layers must line up with the previous filed.
- State thicknesses in nm
- Every layer in the stack has a thickness. If it is unknown, state this as 'nan'
- If there are uncertainties, state the best estimate, e.g. write 100 and not 90-110
- If you only know the total thickness, e.g. you have a 2 mm thick commercial FTO substrate and you do not know how thick the FTO layer is, state that as '2 | nan'

Example:

2.2 | 0.1
2 | nan
nan | nan | nan

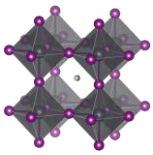
Substrate. Area [cm^2]

Format: Float
Default: nan
Description: The total area in cm^2 of the substrate over which the perovskite is deposited. This may be significantly larger than the cell area

Substrate. Supplier

Format: Text string
Default: Empty text string
Description. The supplier of the substrate.

- Most substrates in the perovskite field are bought commercially, but if it is made in the lab, state this as "lab made"
- If the supplier is unknown, stat that as: 'Unknown'



- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Lab made
NGO
Pilkington

Substrate. Brand name

Format: Text string
Default: Empty text string
Description. The specific brand name of the substrate. e.g. NGO11, TEC15, etc.

- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Substrate. Deposition procedure [Proc. 1 >> Proc. 2 >> … | Proc. 3 >> … | Proc. 4 | …]

Format: Text string
Default: "Unknown"
Description. A list of the deposition procedures for the substrate

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- Make sure that you describe as many layers as there are layers in the stack. Otherwise it will be difficult to interpret which layer the deposition procedure is referring to. It should thus be as many vertical bars in this field as when describing the substrate stack.
- When more than one reaction step, separate them by a double forward angel bracket with one blank space on both sides (' >> ')
- If the deposition procedure for a layer unknown, state that as: 'Unknown'
- If a substrate is bought commercially and you do not know, indicate this by the label "Commercial"
- This category was included after the initial project release wherefor the list of reported purities are short, so be prepared to expand on the given list of alternatives in the extraction protocol.

Example:

Commercial | Commercial
Commercial | Sputtered >> Sputtered
Commercial | ALD

Substrate. Surface roughness. Rms [nm]

Format: Float
Default: nan
Description: The root mean square value (RMS) of the surface roughness expressed in nm

- If not known, leave this field blank

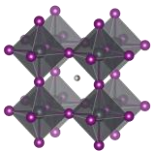
Substrate. Etching procedure

Format: Text string
Default: Empty text string
Description. For the most common substrates, i.e. FTO and ITO it is common that part of the conductive layer is removed before perovskite deposition. State the method by which it was removed

- If there is more than one cleaning step involved, separate the steps by a double forward angel bracket (' >> ')
- This category was included after the initial project release wherefor the list of reported purities are short, so be prepared to expand on the given list of alternatives in the extraction protocol.

Example:

Zn-powder; HCl >> Mecanical scrubbing
Laser etching



Unknown

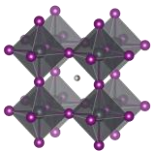
Substrate. Cleaning procedure

Format: Text string
Default: Empty text string
Description. The schematic cleaning sequence of the substrate. The Extraction protocol does not capture the fine details in the cleaning procedures, e.g. times, temperatures, etc. but state the general sequence. Refers to the cleaning of the entire substrate before the deposition of the rest of the cell stack starts.

- If there is more than one cleaning step involved, separate the steps by a double forward angel bracket (' >> ')
- If more than one procedure is occurring simultaneously, e.g. Soap washing an ultrasonic bath, separate simultaneously occurring steps with a semicolon.
- This category was included after the initial project release wherefor the list of reported purities are short, so be prepared to expand on the given list of alternatives in the extraction protocol.

Example:

Helmanex >> Ultrasonic bath >> Ethanol >> Ultrasonic bath >> Acetone >> UV-ozone
Piranha solutionion
Piranha solutionion >> UV-ozone
Soap
Soap >> Ultrasonic bath
Soap >> Ultrasonic bath >> Ethanol; Ultrasonic bath >> Acetone >> UV-ozone
Soap >> Ultrasonic bath >> UV-ozone
Unknown



Electron transport layer

ETL. Stack sequence [Mat.1; Mat.2; … | Mat.3; … | Mat.4 | …]

Format: Text string
Default: "Unknown"
Description: The stack sequence describing the electron transport layer. Use the following formatting guidelines

- With the ETL, we refer to any layer between the substrate and the perovskite in a nip-device, and any layer between the perovskite and the back contact in a pin-device.
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If two materials, e.g. A and B, are mixed in one layer, list the materials in alphabetic order and separate them with semicolons, as in (A; B)
- If no electron transport layer, state that as 'non'
- Use common abbreviations when appropriate but spell it out if risk for confusion.
- If a material is doped, or have an additive, state the pure material here and specify the doping in the columns specifically targeting the doping of those layers.
- There is no sharp well-defined boundary between when a material is best considered as doped or as a mixture of two materials. When in doubt if your material is best described as doped or as a mixture, use the notation that best capture the metaphysical essence of the situation.
- There are a lot of stack sequences described in the literature. Try to find your one in the list. If it is not there (i.e. you may have done something new) define a new stack sequence according to the instructions.

Example: Below are some of the most common electron transport layers

TiO2-c | TiO2-mp
TiO2-c
PCBM-60
PCBM-60 | BCP
SnO2-np
C60 | BCP
SnO2-c
TiO2-c | TiO2-mp | ZrO2-mp
ZnO-c
PCBM-60 | C60 | BCP
PCBM-60 | LiF

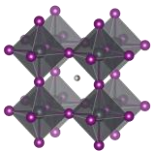
ETL. Thickness [Th.1 | Th.2 | … | Th.n] [nm]

Format: Text string
Default: nan
Description: A list of thicknesses of the individual layers in the stack. Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')

- The layers must line up with the previous filed.
- State thicknesses in nm
- Every layer in the stack has a thickness. If it is unknown, state this as 'nan'
- If there are uncertainties, state the best estimate, e.g. write 100 and not 90-110

Example:

200
nan |250
100 | 5 | 8



ETL. Additives. Compounds [Addt.1; Addt.2; … | Addt.3; … | Addt.4 | …]

Format: Text string
Default: Empty text string
Description: List of the dopants and additives that are in each layer of the ETL-stack

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- The layers must line up with the previous fields.
- If several dopants/additives, e.g. A and B, are present in one layer, list the dopants/additives in alphabetic order and separate them with semicolons, as in (A; B)
- If no dopants/additives, state that as “Undoped”
- If the doping situation is unknown, stat that as: ‘Unknown’

Example:

Undoped | Li-TFSI
TiCl4
Nb
Undoped | Undoped | Undoped

ETL. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; … | c4 mg/ml | …]

Format: Text string
Default: nan
Description: The concentration of the dopants/additives.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- If more than one dopant/additive in the layer, e.g. A and B, separate the concentration for each dopant/additive with semicolons, as in (A; B)
- For each dopant/additive in the layer, state the concentration.
- The order of the dopants/additives must be the same as in the previous filed.
- For layers with no dopants/additives, state this as ‘none’
- When concentrations are unknown, state that as ‘nan’
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used.
- The preferred way to state the concentration of a dopant/additive is to refer to the amount in the final product, i.e. the material in the layer. When possible, use on the preferred units:
    - wt%, mol%, vol%, ppt, ppm, ppb
- When the concentration of the dopant/additive in the final product is unknown, but where the concentration of the dopant/additive in the solution is known, state that concentration instead. When possible, use on the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

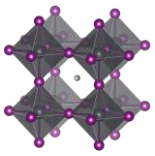
Example:

4 wt%
5 vol%; nan | 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | 0.3 M

ETL. Deposition. Procedure [Proc. 1 >> Proc. 2 >> … | Proc. 3 >> … | Proc. 4 | …]

Format: Text string
Default: “Unknown”
Description: The deposition procedures for the ETL stack.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate them by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- Thermal annealing is generally not considered as an individual reaction step. The philosophy behind this is that every deposition step has a thermal history, which is specified in a separate filed. In



exceptional cases with thermal annealing procedures clearly disconnected from other procedures, state 'Thermal annealing' as a separate reaction step.

- Please read the instructions under "*Perovskite. Deposition. Procedure*" for descriptions and distinctions between common deposition procedures and how they should be labelled for consistency in the database.

Example:

Spin-coating
Spin-coating | Spin-coating
Spray-pyrolys | Spin-coating
Evaporation | Evaporation
Spin-coating | Evaporation
CBD
Spray-pyrolys
Spin-coating | Evaporation | Evaporation
Spray-pyrolys >> CBD | Spin-coating >> CBD

ETL. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> … | Agr. 3 >> … | Agr. 4 | …]

Format: Text string
Default: "Unknown"
Description: The physical state of the reactants

- The three basic categories are Solid/Liquid/Gas
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the aggregation state associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- Most cases are clear cut, e.g. spin-coating involves species in solution and evaporation involves species in gas phase. For less clear-cut cases, consider where the reaction really is happening as in:
    - For a spray-coating procedure, it is droplets of liquid that enters the substrate (thus a liquid phase reaction)
    - For sputtering and thermal evaporation, it is species in gas phase that reaches the substrate (thus a gas phase reaction)
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

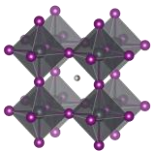
Example:

Liquid
Gas | Liquid
Liquid | Liquid >> Liquid

ETL. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; … >> … | Gas4 >> … | Gas5 | …]

Format: Text string
Default: "Unknown"
Description: The synthesis atmosphere

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the atmospheres associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"



- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

N2
Vacuum | N2
Air | Ar; H2O >> Ar

ETL. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> … | P.3 >> … | P.4 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string

Default: nan

Description: The total pressure during each synthesis step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- Pressures can be stated in different units suited for different situations. Therefore, specify the unit. The preferred units are:
    - atm, bar, mbar, mmHg, Pa, torr, psi
- If a pressure is not known, stat that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 100 pa and not 80-120 pa.

Example:

1 atm
0.002 torr | 10000 Pa
1 atm >> 1 atm | nan

ETL. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> … | P.4 >> … | P.5 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string

Default: nan

Description: The partial pressures for the gases present during each reaction step.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the partial pressures and separate them with semicolons, as in (A; B). The list of partial pressures must line up with the gases they describe.
- In cases where no gas mixtures are used, this field will be the same as the previous filed.

Example:

1 atm
0.002 torr | 10000 Pa
nan >> 0.99 atm; 0.01 atm | 1 atm

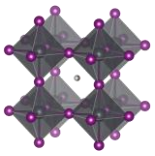
ETL. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> … | RH3 >> … | RH4 | …] [%]

Format: Text string

Default: nan

Description: The relative humidity during each deposition step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')



- When more than one reaction step, separate the relative humidity associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns
- If the relative humidity for a step is not known, stat that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 35 and not 30-40.

Example:

35
0 | 20
25 >> 25 | 0

ETL. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; … >> … | Sol.4 >> … | Sol.5 | …]

Format: Text string

Default: nan

Description: The solvents used in each deposition procedure for each layer in the stack

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvents associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the solvents in alphabetic order and separate them with semicolons, as in (A; B)
- The number and order of layers and deposition steps must line up with the previous columns.
- For non-liquid processes with no solvents, state the solvent as 'none'
- If the solvent is not known, state this as 'Unknown'
- Use common abbreviations when appropriate but spell it out when risk for confusion
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

DMF
Acetonitil; Ethanol | Ethanol
None | Chlorobenzene
H2O >> H2O | Methanol

ETL. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> … | V5; V6 >> … | 1 | …]

Format: Text string

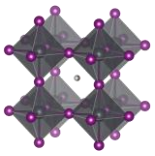
Default: nan

Description: The mixing ratios for mixed solvents

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent mixing ratios associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- For pure solvents, state the mixing ratio as 1
- For non-solvent processes, state the mixing ratio as 1
- For unknown mixing ratios, state the mixing ratio as 'nan'
- For solvent mixtures, i.e. A and B, state the mixing ratios by using semicolons, as in (V_A; V_B)
- The preferred metrics is the volume ratios. If that is not available, mass or mol ratios can be used instead, but it the analysis the mixing ratios will be assumed to be based on volumes.

Example:

9; 0.6; 0.4 | 1
1 >> 1 | 1
9; 1 | 3; 2



ETL. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]
Format: Text string
Default: 'Unknown'
Description: The suppliers of all the solvents.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- For non-liquid processes with no solvents, mark the supplier as 'none'
- If the supplier for a solvent is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Sigma Aldrich
Sigma Aldrich; Fisher | Acros
none >> Sigma Aldrich; Sigma Aldrich | Unknown

ETL. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]
Format: Text string
Default: 'Unknown'
Description: The purity of the solvents used.

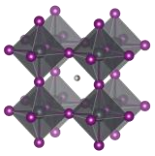
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated purities and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For non-liquid processes with no solvents, state the purity as 'none'
- If the purity for a solvent is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
Puris; Puris| Tecnical
none >> Pro analysis; Pro analysis | Unknown

ETL. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | …]
Format: Text string
Default: nan
Description: The non-solvent precursor chemicals used in each reaction step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the non-solvent chemicals associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several compounds, e.g. A and B, list the associated compounds in alphabetic order and separate them with semicolons, as in (A; B)
- Note that also dopants/additives should be included



- When several precursor solutions are made and mixed before the reaction step, it is the properties of the final mixture used in the reaction we here describe.
- The number and order of layers and reaction steps must line up with the previous columns.
- For gas phase reactions, state the reaction gases as if they were in solution.
- For solid-state reactions, state the compounds as if they were in solution.
- For reaction steps involving only pure solvents, state this as 'none'
- If the compounds for a deposition step is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Titanium diisopropoxide bis(acetylacetonate) | TiO2-np
C60 | BCP
Titanium diisopropoxide bis(acetylacetonate) | TiO2-np >> Li-TFSI

ETL. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]

Format: Text string
Default: 'Unknown'
Description: The suppliers of the non-solvent chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the non-solvent chemical suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- For gas phase reactions, state the suppliers for the gases or the targets/evaporation sources that are evaporated/sputtered/etc.
- For solid state reactions, state the suppliers for the compounds in the same way.
- For reaction steps involving only pure solvents, state the supplier as 'none' (as that that is entered in a separate filed)
- For chemicals that are lab made, state that as "Lab made" or "Lab made (name of lab)"
- If the supplier for a compound is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Dysole; Sigma Aldrich; Dyenamo; Sigma Aldrich
Sigma Aldrich; Fisher | Acros
Lab made (EPFL) | Sigma Aldrich >> none

ETL. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]

Format: Text string
Default: 'Unknown'
Description: The purity of the non-solvent chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the compound purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, i.e. A and B, list the associated purities and separate them with semicolons, as in (A; B)

- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For reaction steps involving only pure solvents, state this as 'none' (as that is stated in another field)
- If the purity for a compound is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
99.999; Puris | Tecnical
Unknown >> Pro analysis; Pro analysis | none

ETL. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> … | c4 wt%; c5 vol% | c6 ppm |…]

Format: Text string
Default: nan
Description: The concentration of the non-solvent precursor chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the concentrations associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, e.g. A and B, list the associated concentrations and separate them with semicolons, as in (A; B)
- The order of the compounds must be the same as in the previous filed.
- For reaction steps involving only pure solvents, state this as 'none'
- When concentrations are unknown, state that as 'nan'
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used. When possible, use one of the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml, wt%, mol%, vol%, ppt, ppm, ppb
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Example:

4 wt%
0.2 M; 0.15 M| 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | nan

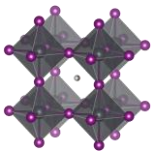
ETL. Deposition. Reaction solutions. Volumes [V1 >> V2 >> … | V3 >> … | V4 | …] [ml]

Format: Text string
Default: nan
Description: The volume of the reaction solutions

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the volumes associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The volumes refer the volumes used, not the volume of the stock solutions. Thus if 0.15 ml of a solution is spin-coated, the volume is 0.15 ml
- For reaction steps without solvents, state the volume as 'nan'
- When volumes are unknown, state that as 'nan'

Example:

0.1
0.1 >> 0.05 | 0.05
nan | 0.15



ETL. Deposition. Reaction solutions. Age [A1 >> A2 >> … | A3 >> … | A4 | …] [h]

Format: Text string
Default: nan
Description: The age of the solutions

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the age of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- As a general guideline, the age refers to the time from the preparation of the final precursor mixture to the reaction procedure.
- When the age of a solution is not known, state that as ‘nan’
- For reaction steps where no solvents are involved, state this as ‘nan’
- For solutions that are stored a long time, an order of magnitude estimate is adequate.

Example:

2
0.25 |1000 >> 10000
nan | nan

ETL. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the reaction solutions.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the temperatures of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- If a reaction solution undergoes a temperature program, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons, e.g. 25; 100
- When the temperature of a solution is unknown, state that as ‘nan’
- For reaction steps where no solvents are involved, state the temperature of the gas or the solid if that make sense. Otherwise state this as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- Assume an undetermined room temperature to be 25

Example:

25
100; 50 | 25
nan | 25 >> 25

ETL. Deposition. Substrate. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the substrate.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the temperatures of the substrates (i.e. the last deposited layer) associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The temperature of the substrate refers to the temperature when the deposition of the layer is occurring.
- If a substrate undergoes a temperature program before the deposition, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)
- When the temperature of a substrate is not known, state that as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- Assume that an undetermined room temperature is 25

Example:

125; 325; 375; 450 | 25 >> 25
100
nan

ETL. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperatures of the thermal annealing program associated with depositing the layers

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the annealing temperatures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- If no thermal annealing is occurring after the deposition of a layer, state that by stating the room temperature (assumed to 25°C if not further specified)
- If the thermal annealing program is not known, state that by 'nan'

Example:

450 | 125; 325; 375; 450 >> 125; 325; 375; 450
50 | 25
nan

ETL. Deposition. Thermal annealing. Time [t1; t2 >> t3; … >> … | t4 >> … | t5 | …] [min]

Format: Text string
Default: nan
Description: The time program associated to the thermal annealing program.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the annealing times associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the associated times at those temperatures and separate them with semicolons.
- The annealing times must align in terms of layers, reaction steps and annealing temperatures in the previous filed.
- If a time is not known, state that by 'nan'
- If no thermal annealing is occurring after the deposition of a layer, state that by 'nan'
- For values with uncertainties, state the best estimate, e.g. write 20 and not 10-30.

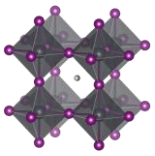
Example:

30 | 5; 5; 5; 30 >> 5; 5; 5; 30
60 | 1000
nan

ETL. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; … >> … | Gas4 >> … | Gas5 | …]

Format: Text string
Default: "Unknown"
Description: The atmosphere during thermal annealing

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the atmospheres associated to each annealing step by a double forward angel bracket with one blank space on both sides (' >> ')



- The number and order of layers and deposition steps must line up with the previous columns.
- If the atmosphere is a mixture of different gases, i.e. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas.
- This is often the same as the atmosphere under which the deposition is occurring, but not always.
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

N2
Vacuum | N2
Air | Ar >> Ar

ETL. Storage. Time until next deposition step [h]

Format: Float
Default: nan
Description: The time between the HTL stack is finalised and the next layer is deposited

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.

ETL. Storage. Atmosphere [Gas1; Gas2; ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere in which the sample with the finalised HTL stack is stored until the next deposition step.
Example:

Air
N2
Vacuum

ETL. Storage. Relative humidity [%]

Format: Float
Default: nan
Description: The relive humidity under which the sample with the finalised HTL stack is stored until next deposition step

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.

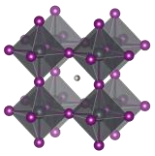
ETL. Surface treatment before next deposition step

Format: Text string
Default: nan
Description: Description of any type of surface treatment or other treatment the sample with the finalised ETL-stack undergoes before the next deposition step.

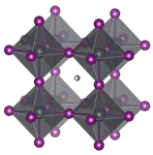
- If more than one treatment, list the treatments and separate them by a double forward angel bracket (' >> ')
- If no special treatment, state that as 'none'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

none
Ar plasma



UV-ozone



The perovskite

Perovskite. Single crystal [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell is based on a perovskite single crystal

Perovskite. Dimension. 0D (Quantum dot) [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell is based on a perovskite quantum dots. Perovskite nanoparticle architectures can also be counted here unless they more have the characteristics of a standard polycrystalline cell

Perovskite. Dimension. 2D [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell is based on 2D perovskites, i.e. a layered perovskite with a large A-cation

Perovskite. Dimension. 2D/3D mixture [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell is based on a mixture of 2D and 3D perovskites. This is sometimes referred to as reduced dimensional perovskites (but not as reduced as to be a pure 2D perovskite)

Perovskite. Dimension. 3D [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE for standard three-dimensional perovskites with ABC_3 structures. TRUE also for the case where the bulk of the perovskite is 3D but where there exist a thin 2D-capping layer

Perovskite. Dimension. 3D with 2D capping layer [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the bulk of the perovskite layer is 3D but there is a top layer with lower dimensionality.

Perovskite. Dimension. List of layers [Dim.1 | Dim.2 | …]

Format: Text string
Default: nan
Description: A list of the perovskite dimensionalities

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- In most cases, there will be only one layer
- For a perovskite that is a mixture of a 2D and a 3D phase, mark this is as: 2.5

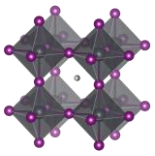
Example:

3
3 | 2
0

Perovskite. Composition. Perovskite ABC3 structure [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the photo-absorber has a perovskite structure

- The typical perovskite has an ABC_3 structure and that is clearly a TRUE



- This category is inclusive in the sense that also 2D perovskite analogues should be labelled as TRUE

Perovskite. Composition. Perovskite inspired structure [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the photo absorber does not have a perovskite structure. In the literature we sometimes see cells based on non-perovskite photo absorbers, but which claims to be "perovskite inspired" regardless if the crystal structure has any resemblance to the perovskite ABC_3 structure or not. This category is for enabling those cells to easily be identified and filtered.

Perovskite. Composition. A-ions [Ion.1; Ion.2; … | Ion.3; … | …]

Format: Text string
Default: nan
Description: List of the A-site ions in the perovskite structure

- We have experimented with letting users write the perovskite structure and from that extract ions and coefficients. Due to the multitude of formatting variations, that has not worked out very well, wherefor we now define the perovskite ion by ion.
- List all the A-site ions in alphabetic order and separate them by semicolons
- For ions which labels are three characters or longer, enclose them in parenthesis. That improves readability and simplifies downstream data treatment.
- In case of a layered perovskite structure, separate layers by a space, a vertical bar, and a space, i.e. (' | ')
- Only include ions that go into the perovskite structure. Ions that only are found in secondary phases, or amorphous grain boundaries, or that disappears during synthesis, should instead be added as dopants/additives in the field dedicated to dopants and additives.
    - On example is Rb in MAFAPbBrI-perovskites. As far as we know, Rb does not go into the perovskite structure, even if that was believed to be the case in the beginning, but rather form secondary phases. For MAFAPbBrI-perovskites, Rb should thus not be considered as a A-site cation, but as a dopant/additive.

Example:

MA
FA; MA
Cs; FA; MA
(5-AVA); MA
Cs; FA; MA | (PEA)

Perovskite. Composition. A-ions. Coefficients [Cof.1; Cof.2; … | Cof.3; … | …]

Format: Text string
Default: nan
Description: A list of the perovskite coefficients for the A-site ions

- The list of coefficients must line up with the list of the A-site ions
- If a coefficient is unknown, state that with an 'x'
- If there are uncertainties in the coefficient, only state the best estimate, e.g. write 0.4 and not 0.3-0.5.
- A common notation is '1-x'. Write that as x
- If the coefficients are not known precisely, a good guess is worth more than to state that we have absolutely no idea.

Examples:

1
0.83; 0.17
0.05; 0.79; 0.16
1.5; 0.5

0.05; 0.79; 0.16 | x

Perovskite. Composition. B-ions [Ion.1; Ion.2; … | Ion.3; … | …]

Format: Text string
Default: nan
Description: List of the B-site ions in the perovskite structure

- We have experimented with letting users write the perovskite structure and from that extract ions and coefficients. Due to the multitude of formatting variations, that has not worked out very well, wherefor we now define the perovskite ion by ion.
- List all the B-site ions in alphabetic order and separate them by semicolons
- In case of a layered perovskite structure, separate layers by a space, a vertical bar, and a space, i.e. (' | ')
- Only include ions that go into the perovskite structure. Ions that only are found in secondary phases, or amorphous grain boundaries, or that disappears during synthesis, should instead be added as dopants/additives in the field dedicated to dopants and additives.

Example:

Pb
Sn
Pb; Sn
Bi
Pb | Pb

Perovskite. Composition. B-ions. Coefficients [Cof.1; Cof.2; … | Cof.3; … | …]

Format: Text string
Default: nan
Description: A list of the perovskite coefficients for the B-site ions

- The list of coefficients must line up with the list of the B-site ions
- If a coefficient is unknown, mark that with an 'x'
- If there are uncertainties in the coefficient, only state the best estimate, e.g. write 0.4 and not 0.3-0.5.
- A common notation is '1-x'. Write that as x
- If the coefficients are not known precisely, a good guess is worth more than to state that we have absolutely no idea.

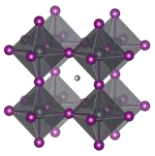
Examples:

1
0.83; 0.17
x; x
0.5; 0.5 | 1

Perovskite. Composition. C-ions [Ion.1; Ion.2; … | Ion.3; … | …]

Format: Text string
Default: nan
Description: List of the C-site ions in the perovskite structure

- We have experimented with letting users write the perovskite structure and from that extract ions and coefficients. Due to the multitude of formatting variations, that has not worked out very well, wherefor we now define the perovskite ion by ion.
- List all the A-site ions in alphabetic order and separate them by semicolons
- For ions which labels are three characters or longer, enclose them in parenthesis. That improves readability and simplifies downstream data treatment.
- In case of a layered perovskite structure, separate layers by a space, a vertical bar, and a space, i.e. (' | ')



- Only include ions that go into the perovskite structure. Ions that only are found in secondary phases, or amorphous grain boundaries, or that disappears during synthesis, should instead be added as dopants/additives in the field dedicated to dopants and additives.
    - One example is chloride in $MAPbI_3$. As far as we know, Cl does not go into the perovskite structure even if that was believed to be the case in the beginning. For $MAPbI_3$ Cl should thus not be considered as a C-site cation, but as a dopant/additive.

Example:

I
Br; I
Br
Br; I | I

Perovskite. Composition. C-ions. Coefficients [Cof.1; Cof.2; … | Cof.3; … | …]

Format: Text string
Default: nan
Description: A list of the perovskite coefficients for the C-site ions

- The list of coefficients must line up with the list of the C-site ions
- If a coefficient is unknown, mark that with an 'x'
- If there are uncertainties in the coefficient, only state the best estimate, e.g. write 0.4 and not 0.3-0.5.
- A common notation is '1-x'. Write that as x
- If the coefficients are not known precisely, a good guess is worth more than to state that we have absolutely no idea.

Examples:

3
0.51; 2.49
0.51; 2.49 | x

Perovskite. Composition. None-stoichiometry. Components in excess [Com.1; Com.2; … | Com.3; … | …]

Format: Text string
Default: nan
Description: Components that are in excess in the perovskite synthesis. E.g. to form stoichiometric $MAPbI_3$, PbI_2 and MAI are mixed in the proportions 1:1. If one of them are in excess compared to the other, then that component is considered to be in excess. This information can be inferred from data entered on the concentration for all reaction solutions, but this gives a convenient shorthand filtering option.

- If more than one component is in excess, order them in alphabetic order and separate them by semicolons.
- It there are no components that are in excess, write Stoichiometric

Examples:

PbI2
MAI
Stoichiometric

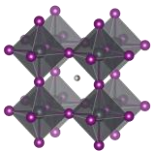
Perovskite. Composition. Short form (A-ions B-ions C-ions. Each in alphabetic order)

Format: Text string
Default: 'Unknown'
Description: The perovskite composition written in shorthand notation, i.e. without coefficients

- **Deprecated. Will in future versions be inferred from data in previous fields**

Perovskite. Composition. Long form (PLEASE FOLLOW INSTRUCTIONS!)

Format: Text string



Default: 'Unknown'
Description: The perovskite composition written in shorthand notation, i.e. without coefficients

- **Deprecated. Will in future versions be inferred from data in previous fields**

Perovskite. Composition. Assumption [Solution composition/Experimental verification/Literature/ …]
Format: Text string
Default: nan
Description: The knowledge base from which the perovskite composition is inferred. Is the assumed perovskite composition based on the composition of the precursor solutions and the assumption that the final perovskite will have the same composition (i.e. Solution composition), or is it based on literature claims (i.e. Literature) or has it been experimentally verified with some technique, e.g. XRD, EDX, XRF, etc.?

Perovskite. Composition. Inorganic perovskite [TRUE/FALSE]
Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the perovskite does not contain any organic ions.

Perovskite. Composition. Lead free [TRUE/FALSE]
Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the perovskite is completely lead free.

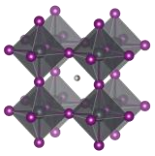
Perovskite. Additives. Compounds [Addt.1; Addt.2; … | Addt.3; … | Addt.4 | …]
Format: Text string
Default: Empty text string
Description: List of the dopants and additives that are in the perovskite

- If the perovskite is layered (e.g. 3D perovskite with a 2D capping layer), separate the layers by a space, a vertical bar, and a space, i.e. (' | ')
- If several dopants/additives, e.g. A and B, are present in one layer, list the dopants/additives in alphabetic order and separate them with semicolons: as in (A; B)
- If no dopants/additives, state that as "Undoped"
- If the doping situation is unknown, stat that as: 'Unknown'
- Include any non-solvent that does not go into the perovskite structure. This includes compounds that are found in secondary phases, or amorphous grain boundaries, or that disappears during synthesis.
    - One example is Rb in MAFAPbBrI-perovskites. As far as we know, Rb does not go into the perovskite structure, even if that was believed to be the case in the beginning, but rather form secondary phases. For MAFAPbBrI-perovskites, Rb should thus not be considered as a A-site cation, but as a dopant/additive.
    - One other example is chloride in $MAPbI_3$. As far as we know, Cl does not go into the perovskite structure even if that was believed to be the case in the beginning. For $MAPbI_3$ Cl should thus not be considered as a C-site cation, but as a dopant/additive.

Example:

Cl
Undoped
5-AVAI
SnF2
Ag; Cl; rGO
Rb

Perovskite. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; … | c4 mg/ml | …]
Format: Text string
Default: nan



Description: The concentration of the dopants/additives.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If more than one dopant/additive in the layer, e.g. A and B, separate the concentration for each dopant/additive with semicolons, as in (A; B)
- For each dopant/additive in the layer, state the concentration.
- The order of the dopants/additives must be the same as in the previous filed.
- For layers with no dopants/additives, state this as 'none'
- When concentrations are unknown, state that as 'nan'
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used.
- The preferred way to state the concentration of a dopant/additive is to refer to the amount in the final product, i.e. the material in the layer. When possible, use on the preferred units:
    - wt%, mol%, vol%, ppt, ppm, ppb
- When the concentration of the dopant/additive in the final product is unknown, but where the concentration of the dopant/additive in the solution is known, state that concentration instead. When possible, use on the preferred units:
    - M, mM, molal; g/ml, mg/ml, μg/ml
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Example:

4 wt%
5 vol%; nan | 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | 0.3 M

Perovskite. Thickness [Th.1 | Th.2 | … | Th.n] [nm]

Format: Text string
Default: nan
Description: The thickness of the perovskite layer

- If the perovskite contains more than one layer, separate those by a space, a vertical bar, and a space, i.e. (' | ')
- State thicknesses in nm
- Every layer in the stack has a thickness. If it is unknown, state this as 'nan'
- If there are uncertainties, state the best estimate, e.g. write 100 and not 90-110
- For cells where the perovskite infiltrates a mesoporous scaffold, state the thickness as starting from the bottom of the infiltrated mesoporous layer to the top of the perovskite layer (i.e. include the thickness of the infiltrated mesoporous layer)

Example:

200
500 |20
600 | nan

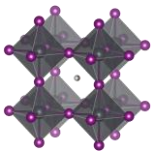
Perovskite. Band gap [Eg.1 | Eg.2 | …] [eV]

Format: Text string
Default: nan
Description: The band gap of the perovskite

- If the perovskite contains more than one layer, separate the band gaps for the respective layer by a space, a vertical bar, and a space, i.e. (' | ')
- If there are uncertainties, state the best estimate, e.g. write 1.62 and not 1.6-1.64

Example:

1.62
1.57 | 2.3



Perovskite. Band gap. Graded [TRUE/FALSE | TRUE/FALSE | ...]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the band gap varies as a function of the vertical position in the perovskite layer.

Perovskite. Band gap. Estimation basis [Absorption/Composition/Literature/EQE/...]

Format: Text string
Default: nan
Description: The method by which the band gap was estimated. The band gap can be estimated from absorption data, EQE-data, UPS-data, or it can be estimated based on literature values for the recipe, or it could be inferred from the composition and what we know of similar but not identical compositions.
Example:

Absorption Tauc-plot
Literature
Composition

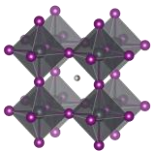
Perovskite. Pl max [PL.1; PL.2; ... | PL.3; ... | ...] [nm]

Format: Text string
Default: nan
Description: The maximum from steady-state PL measurements

- If more than one PL-max, separate those by a semicolon

Example:

780
550; 770



Perovskite deposition

Perovskite. Deposition. Number of deposition steps

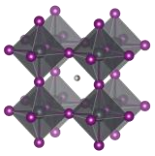
Format: Integer
Default: 0
Description: The number of production steps involved in making the perovskite-stack

- A spin coating program that are composed of several segments with different spin speed are still counted as one step (1)
- A spin coating program involving an antisolvent step counts as a 1-step method (1).
- Depositing PbI_2 first and subsequently converting it to a perovskite count as a 2-step procedure (2)
- Thermal annealing is considered separately. The motivation for this is that every step is considered to have its own thermal history.

Perovskite. Deposition. Procedure [Proc. 1 >> Proc. 2 >> … | Proc. 3 >> … | Proc. 4 | …]

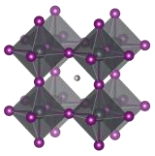
Format: Text string
Default: "Unknown"
Description: The deposition procedures for the perovskite block.

- The perovskite stack is considered as one block/layer when we consider the synthesis. Thus, even if the perovskite is layered, consider it as one block, i.e. no vertical bars in this field
- When more than one reaction step, separate them by a double forward angel bracket with one blank space on both sides (' >> ')
- There should be as many reaction steps described here as indicated in the field "Perovskite. Deposition. Number of deposition steps"
- Thermal annealing is generally not considered as an individual reaction step. The philosophy behind this is that every deposition step has a thermal history, which is specified in a separate filed. In exceptional cases with thermal annealing procedures clearly disconnected from other procedures, state 'Thermal annealing' as a separate reaction step.
- Antisolvent treatment is considered in a separate filed. The motivation for that is that it usually is conducted simultaneously as a spin-coating procedure, and thus acts as an additional aspect of reaction step already accounted for. Exception to this is if there is an antisolvent step that is distinctly separated in time, e.g. a film with a spin-coated perovskite solution is immersed in an antisolvent. In that case, this could be added as a dipp-coating event, while also being reported in the antisolvent field.
- Even if the most common deposition procedures have been used for 95 % of all reported devise, do not be surprised if you do not find your deposition procedure in the list of reported deposition procedure, as the original dataset tended to use a simplified notation.
- A few clarifications
- Air brush spray
    - Deposition with something looking like an old perfume bottle. Classified as a solution technique.
- Brush painting
    - A precursor ink is applied with a brush
- CBD:
    - Chemical bath deposition. Refers to procedures where a film has been immersed in a solution where a reaction occurs. The typical example is when a PbI_2 film is immerse in an IPA solution with MAI in which the PbI_2 is converted to the perovskite.
- Co-evaporation
    - Simultaneous evaporation from multiple sources with line of sight deposition.
- CVD
    - Chemical vapour deposition. A gas phase process where a chemical reaction is occurring in the gas phase. If a MA-containing compound is evaporated and reacted with PbI_2 where another species is released to the gas phase, it is labelled as CVD. A process where MAI in gas phase react with PbI_2 in gas phase is labelled as CVD. A process where MAI or MA gas is reacting with solid PbI_2 is instead labelled as a gas reaction as no chemical reaction is



occurring the gas phase. Note that all reactions labelled as CVD in the literature may not be CVD even if it is conducted in a CVD reactor, and should instead be labelled as a gas reaction.

- Diffusion
  - Solid state reaction where two solid components are mixed. E.g. solid MAI is bought in direct contact with solid PbI_2
- Diffusion-gas reaction
  - A special case. Where one compound, e.g. MAI is placed on top of another e.g. PbI_2 where it is evaporated. It is thus a combination of a gas phase reaction and solid-solid diffusion.
- Dipp-coating
  - The thing that separates dipp-coating from CBD is the occurrence of a reaction. If you have component A in solution, dip your substrate in the solution, take it up and you have component A on your substrate, then you have done a dipp-coating. If you have substance A in solution, dip your substrate in the solution, take it up and have something else than A on your substrate, you have done a CBD (e.g. PbI_2 dipped in MAI/IPA which gives $MAPbI_3$ and not MAI on the substrate)
- Dropcasting
  - A drop is applied to a substrate where it is left to dry without any additional procedures.
- Drop-infiltration
  - A mesoporous scaffold in which a drop of the precursor solution is infiltrated without the aid of spin-coating.
- Doctor blading:
  - There is a family of related techniques, but if it could be described as doctor blading, that is the label to use.
- Evaporation
  - Refers to thermal evaporation with line-of-sigh deposition. i.e. PVD
- Flash evaporation
  - Fast evaporation (in a flash) of a perovskite that sublimes on another substrate. Line of sight deposition.
- Closed space sublimation
  - Evaporation of a well controlled amount of substance (usually in the form of a thin film) in a small container containing the final substrate.
- Gas reaction
  - A gas phase reaction. **Not** a line of sight deposition. In the typical case, MAI is evaporated and the MAI gas builds up a pressure in the reaction chamber in which it reacts with a PbI_2 film forming the perovskite.
- Ion exchange
  - One perovskite is dipped into a solution (or exposed to a gas) which leads to an ion exchange, e.g. I is replaced by Br.
- Lamination
  - A readymade film is transferred directly to the device stack. A rather broad concept. An everyday kitchen related example of lamination would eb to place a thin plastic film over a slice of pie.
- Recrystallization
  - A perovskite that already have been formed is deformed and then recrystallised. E.g. $MAPbI_3$ is exposed to Methylamine gas for a short while which dissolved the perovskite which then can crystallize again
- Rinsing
  - Cleaning step with a solvent
- Sandwiching
  - When a readymade top stack simply is placed on top of the device stack. Could be held together with clams.
- Ultrasonic spray



- A bit like air brush spray but with better control of droplet size. Classified as a solution technique.

Example:

Spin-coating
Spin-coating >> Spin-coating
Spin-coating >> CBD
Spin-coating >> Gas reaction
Drop-infiltration
Co-evaporation
Doctor blading
Evaporation >> Evaporation
Evaporation >> Spin-coating
Evaporation >> Gas reaction
Slot-die coating
Spray-coating

Perovskite. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> … | Agr. 3 >> … | Agr. 4 | …]

Format: Text string
Default: "Unknown"
Description: The physical state of the reactants

- The three basic categories are Solid/Liquid/Gas
- The perovskite stack is considered as one block/layer when we consider the synthesis. Thus, even if the perovskite is layered, consider it as one block, i.e. no vertical bars in this field
- When more than one reaction step, separate the aggregation state associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- Most cases are clear cut, e.g. spin-coating involves species in solution and evaporation involves species in gas phase. For less clear-cut cases, consider where the reaction really is happening as in:
  - For a spray-coating procedure, it is droplets of liquid that enters the substrate (thus a liquid phase reaction)
  - For sputtering and thermal evaporation, it is species in gas phase that reaches the substrate (thus a gas phase reaction)

Example:

Liquid
Gas >> Liquid
Liquid >> Liquid >> Liquid

Perovskite. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; … >> … | Gas4 >> … | Gas5 | …]

Format: Text string
Default: "Unknown"
Description: The synthesis atmosphere

- When more than one reaction step, separate the atmospheres associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas

Example:

N2
Air
N2 >> N2
Vacuum

Perovskite. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> … | P.3 >> … | P.4 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string
Default: nan
Description: The total gas pressure during each reaction step

- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of deposition steps must line up with the previous columns.
- Pressures can be stated in different units suited for different situations. Therefore, specify the unit. The preferred units are:
    - atm, bar, mbar, mmHg, Pa, torr, psi
- If a pressure is not known, stat that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 100 pa and not 80-120 pa.

Example:

1 atm
0.002 torr
1 atm >> 1 atm >> nan

Perovskite. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> … | P.4 >> … | P.5 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string
Default: nan
Description: The partial pressures for the gases present during each reaction step.

- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the partial pressures and separate them with semicolons, as in (A; B). The list of partial pressures must line up with the gases they describe.
- In cases where no gas mixtures are used, this field will be the same as the previous filed.

Example:

1 atm
0.002 torr; 0.03 torr
0.8 atm; 0.2 atm >> 1 atm >> nan

Perovskite. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> … | RH3 >> … | RH4 | …] [%]

Format: Text string
Default: nan
Description: The relative humidity during each deposition step

- When more than one reaction step, separate the relative humidity associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of deposition steps must line up with the previous columns
- If the relative humidity for a step is not known, stat that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 35 and not 30-40.

Example:

35
0 >> 20
25 >> 25 >> 0

Perovskite. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; … >> … | Sol.4 >> … | Sol.5 | …]

Format: Text string
Default: nan
Description: The solvents used in each deposition procedure for each layer in the stack

- When more than one reaction step, separate the solvents associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the solvents in alphabetic order and separate them with semicolons, as in (A; B)
- The number and order of deposition steps must line up with the previous columns.
- For non-liquid processes with no solvents, state the solvent as 'none'
- If the solvent is not known, state this as 'Unknown'
- Use common abbreviations when appropriate but spell it out when risk for confusion

Example:

DMF; DMSO
GBL
DMF >> IPA
DMF >> none
DMF; DMSO >> IPA

Perovskite. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> … | V5; V6 >> … | 1 | …]

Format: Text string
Default: nan
Description: The mixing ratios of the solvents used in each deposition procedure for each layer in the stack

- When more than one reaction step, separate the solvent mixing ratios associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of deposition steps must line up with the previous columns.
- For pure solvents, state the mixing ratio as 1
- For non-solvent processes, state the mixing ratio as 1
- For unknown mixing ratios, state the mixing ratio as 'nan'
- For solvent mixtures, i.e. A and B, state the mixing ratios by using semicolons, as in (V_A; V_B)
- The preferred metrics is the volume ratios. If that is not available, mass or mol ratios can be used instead, but it the analysis the mixing ratios will be assumed to be based on volumes.

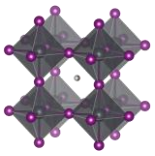
Example:

1
4; 1 >> 1
1 >> 5; 2; 0.3 >> 2; 1

Perovskite. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]

Format: Text string
Default: 'Unknown'
Description: The suppliers of all the solvents.

- When more than one reaction step, separate the solvent suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)



- The number and order of reaction steps and solvents must line up with the previous columns.
- For non-liquid processes with no solvents, mark the supplier as 'none'
- If the supplier for a solvent is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Sigma Aldrich
Sigma Aldrich; Fisher >> Acros
none >> Sigma Aldrich; Sigma Aldrich >> Unknown

Perovskite. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]

Format: Text string
Default: 'Unknown'
Description: The purity of the solvents used.

- When more than one reaction step, separate the solvent purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated purities and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For non-liquid processes with no solvents, state the purity as 'none'
- If the purity for a solvent is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
Puris; Puris>> Tecnical
none >> Pro analysis; Pro analysis >> Unknown

Perovskite. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | …]

Format: Text string
Default: nan
Description: The non-solvent precursor chemicals used in each deposition procedure

- When more than one reaction step, separate the non-solvent chemicals associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several compounds, e.g. A and B, list the associated compounds in alphabetic order and separate them with semicolons, as in (A; B)
- Note that also dopants/additives should be included
- When several precursor solutions are made and mixed before the reaction step, it is the properties of the final mixture used in the reaction we here describe.
- The number and order of reaction steps must line up with the previous columns.
- For gas phase reactions, state the reaction gases as if they were in solution.
- For solid-state reactions, state the compounds as if they were in solution.
- For reaction steps involving only pure solvents, state this as 'none'
- If the compounds for a deposition step is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example

CsI; FAI; MAI; PbBr2; PbI2
PbI2 >> MAI

PbBr2; PbI2 >> FAI; MAI >> none

Perovskite. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]
Format: Text string
Default: 'Unknown'
Description: The suppliers of the non-solvent chemicals.

- When more than one reaction step, separate the non-solvent chemical suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of reaction steps and solvents must line up with the previous columns.
- For gas phase reactions, state the suppliers for the gases or the targets/evaporation sources that are evaporated/sputtered/etc.
- For solid state reactions, state the suppliers for the compounds in the same way.
- For reaction steps involving only pure solvents, state the supplier as 'none' (as that that is entered in a separate filed)
- For chemicals that are lab made, state that as "Lab made" or "Lab made (name of lab)"
- If the supplier for a compound is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Dysole; Sigma Aldrich; Dyenamo; Sigma Aldrich
Sigma Aldrich; Fisher | Acros
Lab made (EPFL) | Sigma Aldrich >> none

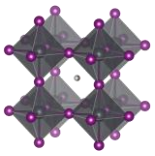
Perovskite. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]
Format: Text string
Default: 'Unknown'
Description: The purity of the chemicals used.

- When more than one reaction step, separate the compound purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, i.e. A and B, list the associated purities and separate them with semicolons, as in (A; B)
- The number and order of reaction steps and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For reaction steps involving only pure solvents, state this as 'none' (as that is stated in another field)
- If the purity for a compound is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
99.999; Puris | Tecnical
Unknown >> Pro analysis; Pro analysis | none

Perovskite. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> … | c4 wt%; c5 vol% | c6 ppm |…]
Format: Text string
Default: nan
Description: The concentration of the non-solvent precursor chemicals.



- When more than one reaction step, separate the concentrations associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of deposition steps and chemicals must line up with the previous columns.
- If a solution contains several dissolved compounds, e.g. A and B, list the associated concentrations and separate them with semicolons, as in (A; B)
- The order of the chemicals must line up to the chemicals in the previous column.
- The order of the compounds must be the same as in the previous filed.
- For reaction steps involving only pure solvents, state this as 'none'
- For gas phase reactions, state the concentration as 'none'
- For solid-state reactions, state the concentration as 'none'
- When concentrations are unknown, state that as 'nan'
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used. When possible, use one of the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml, wt%, mol%, vol%, ppt, ppm, ppb
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Example:

0.063 M; 1.25 M; 1.25 M; 1.14 M; 1.14 M
1.25 M; 1.25 M >> 1.14 M; 1.14 M; 10 mg/ml
1 M; 1 M >> none

Perovskite. Deposition. Reaction solutions. Volumes [V1 >> V2 >> ... | V3 >> ... | V4 | ...] [ml]

Format: Text string
Default: nan
Description: The volume of the reaction solutions used. used in each deposition procedure

- When more than one reaction step, separate the volumes associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The volumes refer the volumes used, not the volume of the stock solutions. Thus if 0.15 ml of a solution is spin-coated, the volume is 0.15 ml
- For reaction steps without solvents, state the volume as 'nan'
- When volumes are unknown, state that as 'nan'

Example

0.04
nan >> 0.1
nan >> 10

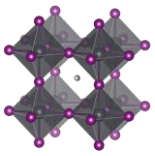
Perovskite. Deposition. Reaction solutions. Age [A1 >> A2 >> ... | A3 >> ... | A4 | ...] [h]

Format: Text string
Default: nan
Description: The age of the solutions used in the deposition

- When more than one reaction step, separate the age of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- As a general guideline, the age refers to the time from the preparation of the final precursor mixture to the reaction procedure.
- When the age of a solution is not known, state that as 'nan'
- For reaction steps where no solvents are involved, state this as 'nan'
- For solutions that are stored a long time, an order of magnitude estimate is adequate.

Example:

0.5
nan >> 10
10000 >> nan



Perovskite. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; ... >> ... | T4 >> ... | T5 | ...] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the reaction solutions.

- If there is more than one reaction step involved, list the solution temperatures and separate the data for each step by a double forward angel bracket (' >> ')
- If a reaction solution undergoes a temperature program, list the temperatures (e.g. start, end, and other important points) and separate them with a semicolon (e.g. heated to 80°C and cooled to room temperature before used would be: 80; 25)
- When the temperature of a solution is not known, state that as 'nan'
- For reaction steps where no solvents are involved, state the temperature of the gas or the solid if that make sense. Otherwise mark this with 'nan'
- Assume that an undetermined room temperature is 25

Example:

25
nan >> 50
80; 25

Perovskite. Deposition. Substrate. Temperature [T1; T2 >> T3; ... >> ... | T4 >> ... | T5 | ...] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the substrate on which the perovskite is deposited.

- When more than one reaction step, separate the temperatures of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a reaction solution undergoes a temperature program, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons, e.g. 25; 100
- When the temperature of a solution is unknown, state that as 'nan'
- For reaction steps where no solvents are involved, state the temperature of the gas or the solid if that make sense. Otherwise state this as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- Assume an undetermined room temperature to be 25

Example:

25
70 >> 25
nan >> 40

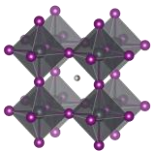
Perovskite. Deposition. Quenching induced crystallisation [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE is measures were taken to discontinuously accelerate the crystallisation process without significantly changing the temperature. i.e. an antisolvent treatment or an analogue process was used.

- The most common case is the antisolvent treatment where a volume of a solvent in which the perovskite is not soluble is poured on the substrate during spin coating.
- The same effect can also be achieved by blowing a gas on the sample
- If the sample quickly after spin coating is subjected to a vacuum, this also counts as quenched induced crystallisation

Perovskite. Deposition. Quenching media [Sol.1; Sol.2; ...]

Format: Text string
Default: 'Unknown'
Description: The solvents used in the antisolvent treatment



- If the antisolvent is a mixture of different solvents, e.g. A and B, list the solvents in alphabetic order and separate them with semicolons: as in (A; B)
- If gas quenching was used, state the gas used
- If the sample quickly after spin coating was subjected to a vacuum, state this as 'Vacuum'
- If an antisolvent was used but it is unknown which one, stat this as "Antisolvent"
- If no antisolvent was used, leave this field blank

Example:

Chlorobenzene
Toluene
Diethyl ether
Ethyl acetate
N2
Vacuum
Anisole

Perovskite. Deposition. Quenching media. Mixing ratios [V1; V2: ...]

Format: Text string
Default: nan
Description: The mixing ratios of the antisolvent

- The order of the solvent must line up with the previous column
- For solvent mixtures, i.e. A and B, state the mixing ratios by using semicolons, as in (V_A; V_B)
- The preferred metrics is the volume ratios. If that is not available, mass or mol ratios can be used instead, but it the analysis the mixing ratios will be assumed to be based on volumes.
- For pure solvents, give the mixing ratio as 1
- For non-solvent processes, give the mixing ratio as 1

Example:

1
4; 1

Perovskite. Deposition. Quenching media. Volume [µl]

Format: Text string
Default: nan
Description: The volume of the antisolvent

- For gas and vacuum assisted quenching, stat the volume as 'nan'
- If the sample is dipped or soaked in the antisolvent, state the volume of the entire solution

Perovskite. Deposition. Quenching media. Additives. Compounds [Addt.1; Addt.2; ...]

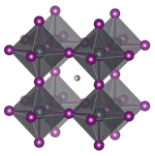
Format: Text string
Default: Empty text string
Description: List of the dopants and additives in the antisolvent

- If several dopants/additives, e.g. A and B, are present, list the dopants/additives in alphabetic order and separate them with semicolons: as in (A; B)
- If no dopants/additives, leave the field blank

Perovskite. Deposition. Quenching media. Additives. Concentrations [c1 M; c2 wt%; c3 mg/ml; ...]

Format: Text string
Default: nan
Description: The concentration of the dopants/additives in the antisolvent

- If more than one dopant/additive in the layer, e.g. A and B, separate the concentration for each dopant/additive with semicolons, as in (A; B)
- For each dopant/additive, state the concentration.



- The order of the dopants/additives must be the same as in the previous filed.
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used.
- The preferred way to state the concentration of a dopant/additive is to refer to the amount in the final product, i.e. the material in the layer. When possible, use on the preferred units:
    - wt%, mol%, vol%, ppt, ppm, ppb
- When the concentration of the dopant/additive in the final product is unknown, but where the concentration of the dopant/additive in the solution is known, state that concentration instead. When possible, use on the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Perovskite. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> ... | T5 | ...] [deg. C]

Format: Text string

Default: nan

Description: The temperatures of the thermal annealing program associated with each deposition step

- When more than one reaction step, separate the annealing temperatures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- If no thermal annealing is occurring after the deposition of a layer, state that by stating the room temperature (assumed to 25°C if not further specified)
- If the thermal annealing program is not known, state that by 'nan'

Example:

100
70; 100 >> 100
25 >> 90; 150

Perovskite. Deposition. Thermal annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> ... | t5 | ...] [min]

Format: Text string

Default: nan

Description: The time program associated to the thermal annealing.

- When more than one reaction step, separate the annealing times associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the associated times at those temperatures and separate them with semicolons.
- The annealing times must align in terms of layers, reaction steps and annealing temperatures in the previous filed.
- If a time is not known, state that by 'nan'
- If no thermal annealing is occurring after the deposition of a layer, state that by 'nan'
- For values with uncertainties, state the best estimate, e.g. write 20 and not 10-30.

Example:

60
5; 30 >> 60
0 >> 5; 5

Perovskite. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> ... | Gas5 | ...]

Format: Text string

Default: "Unknown"
Description: The atmosphere in which the thermal annealing is conducted.

- When more than one reaction step, separate the atmospheres associated to each annealing step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of deposition steps must line up with the previous columns.
- If the atmosphere is a mixture of different gases, i.e. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas.
- This is often the same as the atmosphere under which the deposition is occurring, but not always.
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

N2
Air >> N2
Ar

Perovskite. Deposition. Thermal annealing. Relative humidity [RH1 >> RH2 >> … | RH3 >> … | RH4 | …] [%]

Format: Text string
Default: nan
Description: The relative humidity during the thermal annealing

- If there is more than one annealing step involved, list the associate relative humidity in the surrounding atmosphere and separate them by a double forward angel bracket (' >> ')
- The number and order of annealing steps must line up with the previous column
- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.
- If a humidity is not known, stat that as 'nan'

Example:

0
35 >> 0
nan

Perovskite. Deposition. Thermal annealing. Pressure [P.1 >> P.2 >> … | P.3 >> … | P.4 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string
Default: nan
Description: The atmospheric pressure during the thermal annealing

- If there is more than one annealing step involved, list the associate atmospheric pressures and separate them by a double forward angel bracket (' >> ')
- The number and order of annealing steps must line up with the previous column
- Pressures can be stated in different units suited for different situations. Therefore, specify the unit. The preferred units are:
  - atm, bar, mbar, mmHg, Pa, torr, psi
- If a pressure is not known, stat that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 100 pa and not 80-120 pa.

Example:

1 atm
1 atm >> 0.002 torr
1 atm >> 1 atm >> nan

Perovskite. Deposition. Solvent annealing [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if there has been a separate solvent annealing step, i.e. a step where the perovskite has been annealing in an atmosphere with a significant amount of solvents. This step should also be included deposition procedure sequence but is also stated separately here to simplify downstream filtering.

Perovskite. Deposition. Solvent annealing. Time vs thermal annealing [Before/Under/After/...]

Format: Text string
Default: nan
Description: The timing of the solvent annealing with respect to the thermal annealing step under which the perovskite is formed. There are three options.

- The solvent annealing is conducted before the perovskite is formed.
- The solvent annealing is conducted under the same annealing step in which the perovskite is formed
- The solvent annealing is conducted after the perovskite has formed.

Perovskite. Deposition. Solvent annealing. Solvent atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> ... | Gas5 | ...]

Format: Text string
Default: nan
Description: The solvents used in the solvent annealing step

- If the solvent atmosphere is a mixture of different solvents and gases, e.g. A and B, list them in alphabetic order and separate them with semicolons: as in (A; B)

Example:

DMSO
DMF
DMF; DMSO

Perovskite. Deposition. Solvent annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> ... | t5 | ...] [min]

Format: Text string
Default: nan
Description: The extend of the solvent annealing step in minutes

- If the time is not known, state that by 'nan'
- If the solvent annealing involves a temperature program with multiple temperature stages, list the associated times at each temperature and separate them with a semicolon (e.g. 5; 10)

Perovskite. Deposition. Solvent annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> ... | T5 | ...] [deg. C]

Format: Text string
Default: nan
Description: The temperature during the solvent annealing step

- The temperature refers to the temperature of the sample
- If the solvent annealing involves a temperature program with multiple temperature stages, list the associated temperatures and separate them with a semicolon (e.g. 5; 10) and make sure they align with the times in the previous field.
- If the temperature is not known, state that by 'nan'

Perovskite. Deposition. After treatment of formed perovskite

Format: Text string
Default: nan

Description: Any after treatment of the formed perovskite. Most possible reaction steps should have been entered before this point. This is an extra category for procedures that just does not fit into any of the other categories.
Examples:

Hot isostatic pressing
Magnetic field
UV radiation

Perovskite. Deposition. After treatment of formed perovskite. Metrics

Format: Text string
Default: nan
Description: Connected to the previous field (After treatment of formed perovskite). The label describing the method should be in the previous filed, and the associated metrics in this one. For example: The sample is intense gamma radiation at a flux of X under 45 minutes. The "gamma radiation" is the label, and the time and the flux is the metrics. Give the units when you state the metrics
Examples:

40kHz; 5W; 4 min
45 deg. C
30 min
50 W/cm2; 2.38 s

Perovskite. Storage. Time until next deposition step [h]

Format: Float
Default: nan
Description: The time between the perovskite stack is finalised and the next layer is deposited

- If there are uncertainties, state the best estimate, e.g. write 35 and not 20-50.

Perovskite. Storage. Atmosphere [Gas1; Gas2; ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere in which the sample with the finalised perovskite stack is stored until the next deposition step.
Example:

Air
N2
Vacuum

Perovskite. Storage. Relative humidity [%]

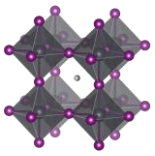
Format: Float
Default: nan
Description: The time between the perovskite stack is finalised and the next layer is deposited

- If there are uncertainties, state the best estimate, e.g. write 35 and not 20-50.

Perovskite. Surface treatment before next deposition step

Format: Text string
Default: nan
Description: Description of any type of surface treatment or other treatment the sample with the finalised perovskite stack undergoes before the next deposition step.

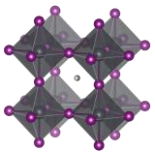
- If more than one treatment, list the treatments and separate them by a double forward angel bracket (' >> ')
- If no special treatment, state that as 'none'
- This category was included after the projects initial phase wherefor the list of reported categories is



short. Thus, be prepared to expand the given list of alternatives in the data template.

Examples:

none
UV
Ozone



Hole transport layer

HTL. Stack sequence [Mat.1; Mat.2; … | Mat.3; … | Mat.4 | …]

Format: Text string
Default: "Unknown"
Description: The stack sequence describing the hole transport layer. Use the following formatting guidelines

- With the HTL, we refer to any layer between the substrate and the perovskite in a pin-device, and any layer between the perovskite and the back contact in a nip-device.
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If two materials, e.g. A and B, are mixed in one layer, list the materials in alphabetic order and separate them with semicolons, as in (A; B)
- If no hole transport layer, state that as 'non'
- Use common abbreviations when appropriate but spell it out if risk for confusion.
- If a material is doped, or have an additive, state the pure material here and specify the doping in the columns specifically targeting the doping of those layers.
- There is no sharp well-defined boundary between when a material is best considered as doped or as a mixture of two materials. When in doubt if your material is best described as doped or as a mixture, use the notation that best capture the metaphysical essence of the situation.
- There are a lot of stack sequences described in the literature. Try to find your one in the list. If it is not there (i.e. you may have done something new) define a new stack sequence according to the instructions.

Example:

Spiro-MeOTAD
PEDOT:PSS
none
NiO-c
PTAA

HTL. Thickness [Th.1 | Th.2 | … | Th.n] [nm]

Format: Text string
Default: nan
Description: A list of thicknesses of the individual layers in the stack.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- The layers must line up with the previous filed.
- State thicknesses in nm
- Every layer in the stack has a thickness. If it is unknown, state this as 'nan'
- If there are uncertainties, state the best estimate, e.g. write 100 and not 90-110

Example:

200
nan |250
100 | 5 | 8

HTL. Additives. Compounds [Addt.1; Addt.2; … | Addt.3; … | Addt.4 | …]

Format: Text string
Default: nan
Description: List of the dopants and additives that are in each layer of the HTL-stack

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- The layers must line up with the previous fields.
- If several dopants/additives, e.g. A and B, are present in one layer, list the dopants/additives in alphabetic order and separate them with semicolons, as in (A; B)
- If no dopants/additives, state that as "Undoped"
- If the doping situation is unknown, stat that as: 'Unknown'

Example:

Li-TFSI; TBP
FK209; Li-TFSI; TBP
F4-TCNQ
Undoped
Cu | Ag; Cu

HTL. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; … | c4 mg/ml | …]

Format: Text string
Default: nan
Description: The concentration of the dopants/additives.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If more than one dopant/additive in the layer, e.g. A and B, separate the concentration for each dopant/additive with semicolons, as in (A; B)
- For each dopant/additive in the layer, state the concentration.
- The order of the dopants/additives must be the same as in the previous filed.
- For layers with no dopants/additives, state this as 'none'
- When concentrations are unknown, state that as 'nan'
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used.
- The preferred way to state the concentration of a dopant/additive is to refer to the amount in the final product, i.e. the material in the layer. When possible, use on the preferred units:
    - wt%, mol%, vol%, ppt, ppm, ppb
- When the concentration of the dopant/additive in the final product is unknown, but where the concentration of the dopant/additive in the solution is known, state that concentration instead. When possible, use on the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Example:

4 wt%
5 vol%; nan | 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | 0.3 M

HTL. Deposition. Procedure [Proc. 1 >> Proc. 2 >> … | Proc. 3 >> … | Proc. 4 | …]

Format: Text string
Default: "Unknown"
Description: The deposition procedures for the HTL-stack.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate them by a double forward angel bracket with one blank space on both sides (' >> ')
- Thermal annealing is generally not considered as an individual reaction step. The philosophy behind this is that every deposition step has a thermal history, which is specified in a separate filed. In exceptional cases with thermal annealing procedures clearly disconnected from other procedures, state 'Thermal annealing' as a separate reaction step.
- Please read the instructions under "*Perovskite. Deposition. Procedure*" for descriptions and distinctions between common deposition procedures and how they should be labelled for consistency in the database.

Example:

Spin-coating
Spin-coating | Spin-coating
Evaporation

Spray-pyrolys

HTL. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; … >> … | Gas4 >> … | Gas5 | …]
Format: Text string
Default: "Unknown"
Description: The synthesis atmosphere.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the atmospheres associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

N2
Vacuum | N2
Air | Ar; H2O >> Ar

HTL. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> … | Agr. 3 >> … | Agr. 4 | …]
Format: Text string
Default: "Unknown"
Description: The physical state of the reactants.

- The three basic categories are Solid/Liquid/Gas
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the aggregation state associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- Most cases are clear cut, e.g. spin-coating involves species in solution and evaporation involves species in gas phase. For less clear-cut cases, consider where the reaction really is happening as in:
    - For a spray-coating procedure, it is droplets of liquid that enters the substrate (thus a liquid phase reaction)
    - For sputtering and thermal evaporation, it is species in gas phase that reaches the substrate (thus a gas phase reaction)
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Liquid
Gas | Liquid
Liquid | Liquid >> Liquid

HTL. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> … | P.3 >> … | P.4 | …] [atm/Torr/Pa/bar/mmHg]
Format: Text string
Default: nan
Description: The total gas pressure during each reaction step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')

- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The number and order of layers and deposition steps must line up with the previous columns.
- Pressures can be stated in different units suited for different situations. Therefore, specify the unit. The preferred units are:
    - atm, bar, mbar, mmHg, Pa, torr, psi
- If a pressure is not known, stat that as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 100 pa and not 80-120 pa.

Example:

1 atm
0.002 torr | 10000 Pa
nan >> 1 atm | 1 atm

HTL. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> … | P.4 >> … | P.5 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string

Default: nan

Description: The partial pressures for the gases present during each reaction step.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The number and order of layers and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the partial pressures and separate them with semicolons, as in (A; B). The list of partial pressures must line up with the gases they describe.
- In cases where no gas mixtures are used, this field will be the same as the previous filed.

Example:

1 atm
0.002 torr | 10000 Pa
nan >> 0.99 atm; 0.01 atm | 1 atm

HTL. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> … | RH3 >> … | RH4 | …] [%]

Format: Text string

Default: nan

Description: The relative humidity during each deposition step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the relative humidity associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The number and order of layers and deposition steps must line up with the previous columns
- If the relative humidity for a step is not known, stat that as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 35 and not 30-40.

Example:

35
0 | 20
nan >> 25 | 0

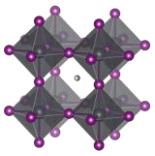
HTL. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; … >> … | Sol.4 >> … | Sol.5 | …]

Format: Text string

Default: nan

Description: The solvents used in each deposition procedure for each layer in the stack

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)



- When more than one reaction step, separate the solvents associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the solvents in alphabetic order and separate them with semicolons, as in (A; B)
- The number and order of layers and deposition steps must line up with the previous columns.
- For non-liquid processes with no solvents, state the solvent as 'none'
- If the solvent is not known, state this as 'Unknown'
- Use common abbreviations when appropriate but spell it out when risk for confusion
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Chlorobenzene
Acetonitile; Ethanol | Chlorobenzene
none >> Ethanol; Methanol; H2O | DMF; DMSO

HTL. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> … | V5; V6 >> … | 1 | …]

Format: Text string
Default: nan
Description: The mixing ratios for mixed solvents

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent mixing ratios associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- For pure solvents, state the mixing ratio as 1
- For non-solvent processes, state the mixing ratio as 1
- For unknown mixing ratios, state the mixing ratio as 'nan'
- For solvent mixtures, i.e. A and B, state the mixing ratios by using semicolons, as in (V_A; V_B)
- The preferred metrics is the volume ratios. If that is not available, mass or mol ratios can be used instead, but it the analysis the mixing ratios will be assumed to be based on volumes.

Example:

1
4; 1 | 1
1 >> 5; 2; 0.3 | 2; 1

HTL. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]

Format: Text string
Default: 'Unknown'
Description: The suppliers of all the solvents.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- For non-liquid processes with no solvents, mark the supplier as 'none'
- If the supplier for a solvent is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Sigma Aldrich

Sigma Aldrich; Fisher | Acros
none >> Sigma Aldrich; Sigma Aldrich | Unknown

HTL. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]

Format: Text string
Default: 'Unknown'
Description: The purity of the solvents used.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated purities and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For non-liquid processes with no solvents, state the purity as 'none'
- If the purity for a solvent is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
Puris; Puris | Tecnical
none >> Pro analysis; Pro analysis | Unknown

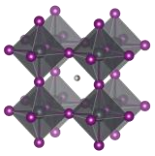
HTL. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | …]

Format: Text string
Default: nan
Description: The non-solvent precursor chemicals used in each reaction step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the non-solvent chemicals associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several compounds, e.g. A and B, list the associated compounds in alphabetic order and separate them with semicolons, as in (A; B)
- Note that also dopants/additives should be included
- When several precursor solutions are made and mixed before the reaction step, it is the properties of the final mixture used in the reaction we here describe.
- The number and order of layers and reaction steps must line up with the previous columns.
- For gas phase reactions, state the reaction gases as if they were in solution.
- For solid-state reactions, state the compounds as if they were in solution.
- For reaction steps involving only pure solvents, state this as 'none'
- If the compounds for a deposition step is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

FK209; Li-TFSI; Spiro-MeOTAD; TBP
NiO-np
PTAA | CuSCN



HTL. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]

Format: Text string
Default: 'Unknown'
Description: The suppliers of the non-solvent chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the non-solvent chemical suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- For gas phase reactions, state the suppliers for the gases or the targets/evaporation sources that are evaporated/sputtered/etc.
- For solid state reactions, state the suppliers for the compounds in the same way.
- For reaction steps involving only pure solvents, state the supplier as 'none' (as that that is entered in a separate filed)
- For chemicals that are lab made, state that as "Lab made" or "Lab made (name of lab)"
- If the supplier for a compound is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Dysole; Sigma Aldrich; Dyenamo; Sigma Aldrich
Sigma Aldrich; Fisher | Acros
Lab made (EPFL) | Sigma Aldrich >> none

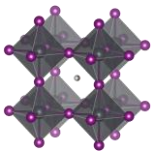
HTL. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]

Format: Text string
Default: 'Unknown'
Description: The purity of the non-solvent chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the compound purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, i.e. A and B, list the associated purities and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For reaction steps involving only pure solvents, state this as 'none' (as that is stated in another field)
- If the purity for a compound is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
99.999; Puris | Tecnical
Unknown >> Pro analysis; Pro analysis | none



HTL. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> … | c4 wt%; c5 vol% | c6 ppm |…]

Format: Text string
Default: nan
Description: The concentration of the non-solvent precursor chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the concentrations associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- If a solution contains several dissolved compounds, e.g. A and B, list the associated concentrations and separate them with semicolons, as in (A; B)
- The order of the compounds must be the same as in the previous filed.
- For reaction steps involving only pure solvents, state this as ‘none’
- When concentrations are unknown, state that as ‘nan’
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used. When possible, use one of the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml, wt%, mol%, vol%, ppt, ppm, ppb
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Example:

4 wt%
0.2 M; 0.15 M| 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | nan

HTL. Deposition. Reaction solutions. Volumes [V1 >> V2 >> … | V3 >> … | V4 | …] [ml]

Format: Text string
Default: nan
Description: The volume of the reaction solutions

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the volumes associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The volumes refer the volumes used, not the volume of the stock solutions. Thus if 0.15 ml of a solution is spin-coated, the volume is 0.15 ml
- For reaction steps without solvents, state the volume as ‘nan’
- When volumes are unknown, state that as ‘nan’

Example:

0.1
0.1 >> 0.05 | 0.05
nan | 0.15

HTL. Deposition. Reaction solutions. Age [A1 >> A2 >> … | A3 >> … | A4 | …] [h]

Format: Text string
Default: nan
Description: The age of the solutions

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the age of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- As a general guideline, the age refers to the time from the preparation of the final precursor mixture to the reaction procedure.
- When the age of a solution is not known, state that as ‘nan’
- For reaction steps where no solvents are involved, state this as ‘nan’
- For solutions that are stored a long time, an order of magnitude estimate is adequate.

Example:

2
0.25 |1000 >> 10000
nan | nan

HTL. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the reaction solutions.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the temperatures of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a reaction solution undergoes a temperature program, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons, e.g. 25; 100
- When the temperature of a solution is unknown, state that as 'nan'
- For reaction steps where no solvents are involved, state the temperature of the gas or the solid if that make sense. Otherwise state this as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- Assume an undetermined room temperature to be 25

Example:

25
100; 50 | 25
nan | 25 >> 25

HTL. Deposition. Substrate. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the substrate.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the temperatures of the substrates (i.e. the last deposited layer) associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The temperature of the substrate refers to the temperature when the deposition of the layer is occurring.
- If a substrate undergoes a temperature program before the deposition, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)
- When the temperature of a substrate is not known, state that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- Assume that an undetermined room temperature is 25

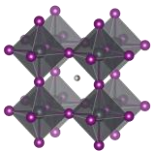
Example:

25
nan
125; 325; 375; 450 | 25 >> 25

HTL. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperatures of the thermal annealing program associated with depositing the layers

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the annealing temperatures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')



- If the thermal annealing involves a temperature program with multiple temperature stages, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- If no thermal annealing is occurring after the deposition of a layer, state that by stating the room temperature (assumed to 25°C if not further specified)
- If the thermal annealing program is not known, state that by 'nan'

Example:

25
50 | nan
450 | 125; 325; 375; 450 >> 125; 325; 375; 450

HTL. Deposition. Thermal annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> ... | t5 | ...] [min]

Format: Text string
Default: nan
Description: The time program associated to the thermal annealing program.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the annealing times associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the associated times at those temperatures and separate them with semicolons.
- The annealing times must align in terms of layers, reaction steps and annealing temperatures in the previous filed.
- If a time is not known, state that by 'nan'
- If no thermal annealing is occurring after the deposition of a layer, state that by 'nan'
- For values with uncertainties, state the best estimate, e.g. write 20 and not 10-30.

Example:

nan
60 | 1000
30 | 5; 5; 5; 30 >> 5; 5; 5; 30

HTL. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> ... | Gas5 | ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere during thermal annealing

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the atmospheres associated to each annealing step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the atmosphere is a mixture of different gases, i.e. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas.
- This is often the same as the atmosphere under which the deposition is occurring, but not always.
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

N2

Vacuum | N2
Air | Ar >> Ar

HTL. Storage. Time until next deposition step [h]

Format: Float
Default: nan
Description: The time between the HTL stack is finalised and the next layer is deposited

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.

HTL. Storage. Atmosphere [Gas1; Gas2; ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere in which the sample with the finalised HTL stack is stored until the next deposition step.
Example:

Air
N2
Vacuum

HTL. Storage. Relative humidity [%]

Format: Float
Default: nan
Description: The relive humidity under which the sample with the finalised HTL stack is stored until next deposition step

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.

HTL. Surface treatment before next deposition step

Format: Text string
Default: nan
Description: Description of any type of surface treatment or other treatment the sample with the finalised HTL stack undergoes before the next deposition step.

- If more than one treatment, list the treatments and separate them by a double forward angel bracket (' >> ')
- If no special treatment, state that as 'none'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

none
Ar plasma
UV-ozone

Back contact

Backcontact. Stack sequence [Mat.1; Mat.2; … | Mat.3; … | Mat.4 | …]

Format: Text string
Default: "Unknown"
Description: The stack sequence describing the back contact.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If two materials, e.g. A and B, are mixed in one layer, list the materials in alphabetic order and separate them with semicolons, as in (A; B)
- If no back contact, state that as 'non'
- Use common abbreviations when appropriate but spell it out if risk for confusion.
- If a material is doped, or have an additive, state the pure material here and specify the doping in the columns specifically targeting the doping of those layers.
- There is no sharp well-defined boundary between when a material is best considered as doped or as a mixture of two materials. When in doubt if your material is best described as doped or as a mixture, use the notation that best capture the metaphysical essence of the situation.
- There are a lot of stack sequences described in the literature. Try to find your one in the list. If it is not there (i.e. you may have done something new) define a new stack sequence according to the instructions.

Example:

Au
Ag
Al
Carbon
MoO3 | Ag

Backcontact. Thickness. List [Th.1 | Th.2 | … | Th.n] [nm]

Format: Text string
Default: nan
Description: A list of thicknesses of the individual layers in the stack.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- The layers must line up with the previous filed.
- State thicknesses in nm
- Every layer in the stack has a thickness. If it is unknown, state this as 'nan'
- If there are uncertainties, state the best estimate, e.g. write 100 and not 90-110

Example:

100
10 | 80
nan | 100

Backcontact. Additives. Compounds [Addt.1; Addt.2; … | Addt.3; … | Addt.4 | …]

Format: Text string
Default: nan
Description: List of the dopants and additives that are in each layer of the HTL-stack

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- The layers must line up with the previous fields.
- If several dopants/additives, e.g. A and B, are present in one layer, list the dopants/additives in alphabetic order and separate them with semicolons, as in (A; B)
- If no dopants/additives, state that as "Undoped"
- If the doping situation is unknown, stat that as: 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is

short. Thus, be prepared to expand the given list of alternatives in the data template, even if to most common back contacts is undoped metals

Example:

CuS
B; P
Au-np | Undoped

Backcontact. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; … | c4 mg/ml | …]

Format: Text string
Default: nan
Description: The concentration of the dopants/additives.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If more than one dopant/additive in the layer, e.g. A and B, separate the concentration for each dopant/additive with semicolons, as in (A; B)
- For each dopant/additive in the layer, state the concentration.
- The order of the dopants/additives must be the same as in the previous filed.
- For layers with no dopants/additives, state this as 'none'
- When concentrations are unknown, state that as 'nan'
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used.
- The preferred way to state the concentration of a dopant/additive is to refer to the amount in the final product, i.e. the material in the layer. When possible, use on the preferred units:
    - wt%, mol%, vol%, ppt, ppm, ppb
- When the concentration of the dopant/additive in the final product is unknown, but where the concentration of the dopant/additive in the solution is known, state that concentration instead. When possible, use on the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

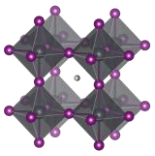
Example:

4 wt%
5 vol%; nan | 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | 0.3 M

Backcontact. Deposition. Procedure [Proc. 1 >> Proc. 2 >> … | Proc. 3 >> … | Proc. 4 | …]

Format: Text string
Default: "Unknown"
Description: The deposition procedures for the HTL-stack.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate them by a double forward angel bracket with one blank space on both sides (' >> ')
- Thermal annealing is generally not considered as an individual reaction step. The philosophy behind this is that every deposition step has a thermal history, which is specified in a separate filed. In exceptional cases with thermal annealing procedures clearly disconnected from other procedures, state 'Thermal annealing' as a separate reaction step.
- Please read the instructions under "*Perovskite. Deposition. Procedure*" for descriptions and distinctions between common deposition procedures and how they should be labelled for consistency in the database.
- A few additional clarifications:
- Lamination
    - A readymade film is transferred directly to the device stack. A rather broad concept. An everyday kitchen related example of lamination would eb to place a thin plastic film over a slice of pie.



- Sandwiching
    - When a readymade top stack simply is placed on top of the device stack. Could be held together with clams. The typical example is a when a "Carbon | FTO | SLG" is placed on top of the device stack. Standard procedure in the DSSC filed.

Example:

Evaporation
Evaporation | Evaporation
Doctor blading
Screen printing
Sputtering
Lamination
E-beam evaporation
Sandwiching

Backcontact. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> … | Agr. 3 >> … | Agr. 4 | …]

Format: Text string
Default: "Unknown"
Description: The physical state of the reactants.

- The three basic categories are Solid/Liquid/Gas
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the aggregation state associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- Most cases are clear cut, e.g. spin-coating involves species in solution and evaporation involves species in gas phase. For less clear-cut cases, consider where the reaction really is happening as in:
    - For a spray-coating procedure, it is droplets of liquid that enters the substrate (thus a liquid phase reaction)
    - For sputtering and thermal evaporation, it is species in gas phase that reaches the substrate (thus a gas phase reaction)
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

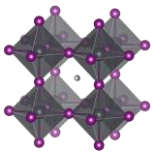
Example:

Liquid
Gas | Liquid
Liquid | Liquid >> Liquid

Backcontact. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; … >> … | Gas4 >> … | Gas5 | …]

Format: Text string
Default: "Unknown"
Description: The synthesis atmosphere.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the atmospheres associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas



- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Vacuum
Vacuum | N2
Air | Ar; H2O >> Ar

Backcontact. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> … | P.3 >> … | P.4 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string
Default: nan
Description: The total gas pressure during each reaction step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The number and order of layers and deposition steps must line up with the previous columns.
- Pressures can be stated in different units suited for different situations. Therefore, specify the unit. The preferred units are:
  - atm, bar, mbar, mmHg, Pa, torr, psi
- If a pressure is not known, stat that as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 100 pa and not 80-120 pa.

Example:

1 atm
0.002 torr | 10000 Pa
nan >> 1 atm | 1 atm

Backcontact. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> … | P.4 >> … | P.5 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string
Default: nan
Description: The partial pressures for the gases present during each reaction step.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The number and order of layers and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the partial pressures and separate them with semicolons, as in (A; B). The list of partial pressures must line up with the gases they describe.
- In cases where no gas mixtures are used, this field will be the same as the previous filed.

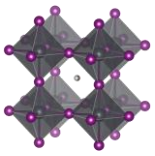
Example:

1 atm
0.002 torr | 10000 Pa
nan >> 0.99 atm; 0.01 atm | 1 atm

Backcontact. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> … | RH3 >> … | RH4 | …] [%]

Format: Text string
Default: nan
Description: The relative humidity during each deposition step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)



- When more than one reaction step, separate the relative humidity associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The number and order of layers and deposition steps must line up with the previous columns
- If the relative humidity for a step is not known, stat that as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 35 and not 30-40.

Example:

35
0 | 20
nan >> 25 | 0

Backcontact. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; … >> … | Sol.4 >> … | Sol.5 | …]

Format: Text string
Default: nan
Description: The solvents used in each deposition procedure for each layer in the stack

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the solvents associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- If a solvent is a mixture of different solvents, e.g. A and B, list the solvents in alphabetic order and separate them with semicolons, as in (A; B)
- The number and order of layers and deposition steps must line up with the previous columns.
- For non-liquid processes with no solvents, state the solvent as ‘none’
- If the solvent is not known, state this as ‘Unknown’
- Use common abbreviations when appropriate but spell it out when risk for confusion
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

none
Acetonitile; Ethanol | Chlorobenzene
none >> Ethanol; Methanol; H2O | DMF; DMSO

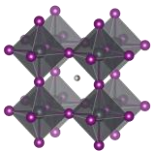
Backcontact. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> … | V5; V6 >> … | 1 | …]

Format: Text string
Default: nan
Description: The mixing ratios for mixed solvents

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the solvent mixing ratios associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The number and order of layers and deposition steps must line up with the previous columns.
- For pure solvents, state the mixing ratio as 1
- For non-solvent processes, state the mixing ratio as 1
- For unknown mixing ratios, state the mixing ratio as ‘nan’
- For solvent mixtures, i.e. A and B, state the mixing ratios by using semicolons, as in (V_A; V_B)
- The preferred metrics is the volume ratios. If that is not available, mass or mol ratios can be used instead, but it the analysis the mixing ratios will be assumed to be based on volumes.

Example:

1
4; 1 | 1
1 >> 5; 2; 0.3 | 2; 1



Backcontact. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]
Format: Text string
Default: 'Unknown'
Description: The suppliers of all the solvents.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- For non-liquid processes with no solvents, mark the supplier as 'none'
- If the supplier for a solvent is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Sigma Aldrich
Sigma Aldrich; Fisher | Acros
none >> Sigma Aldrich; Sigma Aldrich | Unknown

Backcontact. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]
Format: Text string
Default: 'Unknown'
Description: The purity of the solvents used.

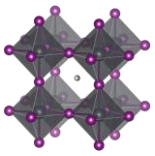
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated purities and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For non-liquid processes with no solvents, state the purity as 'none'
- If the purity for a solvent is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
Puris; Puris| Tecnical
none >> Pro analysis; Pro analysis | Unknown

Backcontact. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | …]
Format: Text string
Default: nan
Description: The non-solvent precursor chemicals used in each reaction step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the non-solvent chemicals associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several compounds, e.g. A and B, list the associated compounds in alphabetic order and separate them with semicolons, as in (A; B)
- Note that also dopants/additives should be included



- When several precursor solutions are made and mixed before the reaction step, it is the properties of the final mixture used in the reaction we here describe.
- The number and order of layers and reaction steps must line up with the previous columns.
- For gas phase reactions, state the reaction gases as if they were in solution.
- For solid-state reactions, state the compounds as if they were in solution.
- For reaction steps involving only pure solvents, state this as 'none'
- If the compounds for a deposition step is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

FK209; Li-TFSI; Spiro-MeOTAD; TBP
NiO-np
PTAA | CuSCN

Backcontact. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]

Format: Text string
Default: 'Unknown'
Description: The suppliers of the non-solvent chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the non-solvent chemical suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- For gas phase reactions, state the suppliers for the gases or the targets/evaporation sources that are evaporated/sputtered/etc.
- For solid state reactions, state the suppliers for the compounds in the same way.
- For reaction steps involving only pure solvents, state the supplier as 'none' (as that that is entered in a separate filed)
- For chemicals that are lab made, state that as "Lab made" or "Lab made (name of lab)"
- If the supplier for a compound is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

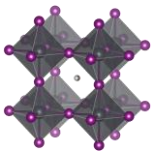
Example:

Dysole; Sigma Aldrich; Dyenamo; Sigma Aldrich
Sigma Aldrich; Fisher | Acros
Lab made (EPFL) | Sigma Aldrich >> none

Backcontact. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]

Format: Text string
Default: 'Unknown'
Description: The purity of the non-solvent chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the compound purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, i.e. A and B, list the associated purities and separate them with semicolons, as in (A; B)



- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For reaction steps involving only pure solvents, state this as 'none' (as that is stated in another field)
- If the purity for a compound is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
99.999; Puris | Tecnical
Unknown >> Pro analysis; Pro analysis | none

Backcontact. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> … | c4 wt%; c5 vol% | c6 ppm |…]

Format: Text string
Default: nan
Description: The concentration of the non-solvent precursor chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the concentrations associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, e.g. A and B, list the associated concentrations and separate them with semicolons, as in (A; B)
- The order of the compounds must be the same as in the previous filed.
- For reaction steps involving only pure solvents, state this as 'none'
- When concentrations are unknown, state that as 'nan'
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used. When possible, use one of the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml, wt%, mol%, vol%, ppt, ppm, ppb
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Example:

4 wt%
0.2 M; 0.15 M| 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | nan

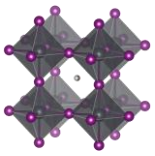
Backcontact. Deposition. Reaction solutions. Volumes [V1 >> V2 >> … | V3 >> … | V4 | …] [ml]

Format: Text string
Default: nan
Description: The volume of the reaction solutions

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the volumes associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The volumes refer the volumes used, not the volume of the stock solutions. Thus if 0.15 ml of a solution is spin-coated, the volume is 0.15 ml
- For reaction steps without solvents, state the volume as 'nan'
- When volumes are unknown, state that as 'nan'

Example:

0.1
0.1 >> 0.05 | 0.05
nan | 0.15



Backcontact. Deposition. Reaction solutions. Age [A1 >> A2 >> … | A3 >> … | A4 | …] [h]

Format: Text string
Default: nan
Description: The age of the solutions

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the age of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- As a general guideline, the age refers to the time from the preparation of the final precursor mixture to the reaction procedure.
- When the age of a solution is not known, state that as ‘nan’
- For reaction steps where no solvents are involved, state this as ‘nan’
- For solutions that are stored a long time, an order of magnitude estimate is adequate.

Example:

2
0.25 |1000 >> 10000
nan | nan

Backcontact. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the reaction solutions.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the temperatures of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- If a reaction solution undergoes a temperature program, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons, e.g. 25; 100
- When the temperature of a solution is unknown, state that as ‘nan’
- For reaction steps where no solvents are involved, state the temperature of the gas or the solid if that make sense. Otherwise state this as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- Assume an undetermined room temperature to be 25

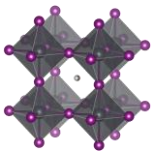
Example:

25
100; 50 | 25
nan | 25 >> 25

Backcontact. Deposition. Substrate. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the substrate.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the temperatures of the substrates (i.e. the last deposited layer) associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The temperature of the substrate refers to the temperature when the deposition of the layer is occurring.
- If a substrate undergoes a temperature program before the deposition, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)
- When the temperature of a substrate is not known, state that as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.



- Assume that an undetermined room temperature is 25

Example:

25
nan
125; 325; 375; 450 | 25 >> 25

Backcontact. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string

Default: nan

Description: The temperatures of the thermal annealing program associated with depositing the layers

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the annealing temperatures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- If no thermal annealing is occurring after the deposition of a layer, state that by stating the room temperature (assumed to 25°C if not further specified)
- If the thermal annealing program is not known, state that by 'nan'

Example:

25
50 | nan
450 | 125; 325; 375; 450 >> 125; 325; 375; 450

Backcontact. Deposition. Thermal annealing. Time [t1; t2 >> t3; … >> … | t4 >> … | t5 | …] [min]

Format: Text string

Default: nan

Description: The time program associated to the thermal annealing program.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the annealing times associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the associated times at those temperatures and separate them with semicolons.
- The annealing times must align in terms of layers, reaction steps and annealing temperatures in the previous filed.
- If a time is not known, state that by 'nan'
- If no thermal annealing is occurring after the deposition of a layer, state that by 'nan'
- For values with uncertainties, state the best estimate, e.g. write 20 and not 10-30.

Example:

nan
60 | 1000
30 | 5; 5; 5; 30 >> 5; 5; 5; 30

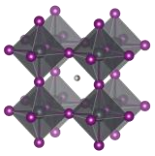
Backcontact. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; … >> … | Gas4 >> … | Gas5 | …]

Format: Text string

Default: "Unknown"

Description: The atmosphere during thermal annealing

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')



- When more than one reaction step, separate the atmospheres associated to each annelaing step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the atmosphere is a mixture of different gases, i.e. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas.
- This is often the same as the atmosphere under which the deposition is occurring, but not always.
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

N2
Vacuum | N2
Air | Ar >> Ar

Backcontact. Storage. Time until next deposition step [h]

Format: Float
Default: nan
Description: The time between the back contact is finalised and the next layer is deposited

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.
- If this is the last layer in the stack, state this as 'nan'

Backcontact. Storage. Atmosphere [Gas1; Gas2; ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere in which the sample with the finalised back contact is stored until the next deposition step or device performance measurement
Example:

Air
N2
Vacuum

Backcontact. Storage. Relative humidity [%]

Format: Float
Default: nan
Description: The relive humidity under which the sample with the finalised back contact is stored until the next deposition step or device performance measurement

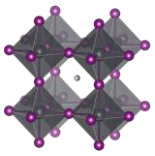
- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.

Backcontact. Surface treatment before next deposition step

Format: Text string
Default: nan
Description: Description of any type of surface treatment or other treatment the sample with the finalised back contact is stored until the next deposition step or device performance measurement

- If more than one treatment, list the treatments and separate them by a double forward angel bracket (' >> ')
- If no special treatment, state that as 'none'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:



none
Ar plasma
UV-ozone

Additional layers, e.g. encapsulation, antireflective coatings, etc.

Add. Lay. Frontside. [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if there is a functional layer below the substrate, i.e. on the opposite side of the substrate from with respect to the perovskite.

Add. Lay. Frontside. Function [A.R.C./Upconversion/Down conversion/Back reflection/ ...]

Format: Text string
Default: Empty text string
Description: The function of the additional layers on the substrate side

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If a layer has more than one function, e.g. A and B, list the functions in order and separate them with semicolons, as in (A; B)

Example:

A.R.C.
Back reflection
Down conversion
Encapsulation
Light management
Upconversion

Add. Lay. Frontside. Stack sequence [Mat.1; Mat.2; ... | Mat.3; ... | Mat.4 | ...]

Format: Text string
Default: "Unknown"
Description: The stack sequence describing the additional layers on the substrate side

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If two materials, e.g. A and B, are mixed in one layer, list the materials in alphabetic order and separate them with semicolons, as in (A; B)
- Use common abbreviations when appropriate but spell it out if risk for confusion.
- There are now separate filed for doping. Indicate doping with colons. E.g. wither aluminium doped NiO-np as Al:NiO-np
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

MgF2
Au-np
NaYF4:Eu-np

Add. Lay. Frontside. Thickness. List [Th.1 | Th.2 | ... | Th.n] [nm]

Format: Text string
Default: nan
Description: A list of thicknesses of the individual layers in the stack.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- The layers must line up with the previous filed.
- State thicknesses in nm
- Every layer in the stack has a thickness. If it is unknown, state this as 'nan'
- If there are uncertainties, state the best estimate, e.g. write 100 and not 90-110

Example:

200

nan |250
100 | 5 | 8

Add. Lay. Frontside. Additives. Compounds [Addt.1; Addt.2; … | Addt.3; … | Addt.4 | …]
Format: Text string
Default: nan
Description: List of the dopants and additives that are in each layer of the HTL-stack

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- The layers must line up with the previous fields.
- If several dopants/additives, e.g. A and B, are present in one layer, list the dopants/additives in alphabetic order and separate them with semicolons, as in (A; B)
- If no dopants/additives, state that as "Undoped"
- If the doping situation is unknown, stat that as: 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template, even if to most common back contacts is undoped metals

Add. lay. Fronside. Additives. Concentrations [c1 M; c2 wt%; … | c3 vol%; … | c4 mg/ml | …]
Format: Text string
Default: nan
Description: The concentration of the dopants/additives.

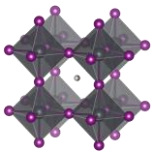
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If more than one dopant/additive in the layer, e.g. A and B, separate the concentration for each dopant/additive with semicolons, as in (A; B)
- For each dopant/additive in the layer, state the concentration.
- The order of the dopants/additives must be the same as in the previous filed.
- For layers with no dopants/additives, state this as 'none'
- When concentrations are unknown, state that as 'nan'
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used.
- The preferred way to state the concentration of a dopant/additive is to refer to the amount in the final product, i.e. the material in the layer. When possible, use on the preferred units:
    - wt%, mol%, vol%, ppt, ppm, ppb
- When the concentration of the dopant/additive in the final product is unknown, but where the concentration of the dopant/additive in the solution is known, state that concentration instead. When possible, use on the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Example:

4 wt%
5 vol%; nan | 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | 0.3 M

Add. Lay. Frontside. Deposition. Procedure [Proc. 1 >> Proc. 2 >> … | Proc. 3 >> … | Proc. 4 | …]
Format: Text string
Default: "Unknown"
Description: The deposition procedures.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate them by a double forward angel bracket with one blank space on both sides (' >> ')



- Please read the instructions under "*Perovskite. Deposition. Procedure*" for descriptions and distinctions between common deposition procedures and how they should be labelled for consistency in the database.
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Evaporation
Spin-coating
Sputtering | ALD

Add. lay. Fronside. Deposition. Aggregation state of reactants (Liquid/Gas/Solid) [Agr. 1 >> Agr. 2 >> … | Agr. 3 >> … | Agr. 4 | …]

Format: Text string
Default: "Unknown"
Description: The physical state of the reactants.

- The three basic categories are Solid/Liquid/Gas
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the aggregation state associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- Most cases are clear cut, e.g. spin-coating involves species in solution and evaporation involves species in gas phase. For less clear-cut cases, consider where the reaction really is happening as in:
    - For a spray-coating procedure, it is droplets of liquid that enters the substrate (thus a liquid phase reaction)
    - For sputtering and thermal evaporation, it is species in gas phase that reaches the substrate (thus a gas phase reaction)
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Liquid
Gas | Liquid
Liquid | Liquid >> Liquid

Add. lay. Fronside. Deposition. Synthesis atmosphere [Gas1; Gas2 >> Gas3; … >> … | Gas4 >> … | Gas5 | …]

Format: Text string
Default: "Unknown"
Description: The synthesis atmosphere.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the atmospheres associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Vacuum

Vacuum | N2
Air | Ar; H2O >> Ar

Add. lay. Fronside. Deposition. Synthesis atmosphere. Pressure. Total [P.1 >> P.2 >> … | P.3 >> … | P.4 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string
Default: nan
Description: The total gas pressure during each reaction step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- Pressures can be stated in different units suited for different situations. Therefore, specify the unit. The preferred units are:
    - atm, bar, mbar, mmHg, Pa, torr, psi
- If a pressure is not known, stat that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 100 pa and not 80-120 pa.

Example:

1 atm
0.002 torr | 10000 Pa
nan >> 1 atm | 1 atm

Add. lay. Fronside. Deposition. Synthesis atmosphere. Pressure. Partial [P.1; P.2 >> P.3 >> … | P.4 >> … | P.5 | …] [atm/Torr/Pa/bar/mmHg]

Format: Text string
Default: nan
Description: The partial pressures for the gases present during each reaction step.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the pressures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the synthesis atmosphere is a mixture of different gases, e.g. A and B, list the partial pressures and separate them with semicolons, as in (A; B). The list of partial pressures must line up with the gases they describe.
- In cases where no gas mixtures are used, this field will be the same as the previous filed.

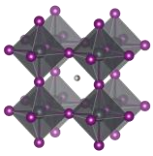
Example:

1 atm
0.002 torr | 10000 Pa
nan >> 0.99 atm; 0.01 atm | 1 atm

Add. lay. Fronside. Deposition. Synthesis atmosphere. Relative humidity [RH1 >> RH2 >> … | RH3 >> … | RH4 | …] [%]

Format: Text string
Default: nan
Description: The relative humidity during each deposition step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the relative humidity associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns



- If the relative humidity for a step is not known, stat that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 35 and not 30-40.

Example:

35
0 | 20
nan >> 25 | 0

Add. lay. Fronside. Deposition. Solvents [Sol.1; Sol.2 >> Sol.3; ... >> ... | Sol.4 >> ... | Sol.5 | ...]

Format: Text string

Default: nan

Description: The solvents used in each deposition procedure for each layer in the stack

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvents associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the solvents in alphabetic order and separate them with semicolons, as in (A; B)
- The number and order of layers and deposition steps must line up with the previous columns.
- For non-liquid processes with no solvents, state the solvent as 'none'
- If the solvent is not known, state this as 'Unknown'
- Use common abbreviations when appropriate but spell it out when risk for confusion
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

none
Acetonitile; Ethanol | Chlorobenzene
none >> Ethanol; Methanol; H2O | DMF; DMSO

Add. lay. Fronside. Deposition. Solvents. Mixing ratios [V1; V2 >> V3; V4 >> ... | V5; V6 >> ... | 1 | ...]

Format: Text string

Default: nan

Description: The mixing ratios for mixed solvents

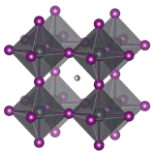
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent mixing ratios associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- For pure solvents, state the mixing ratio as 1
- For non-solvent processes, state the mixing ratio as 1
- For unknown mixing ratios, state the mixing ratio as 'nan'
- For solvent mixtures, i.e. A and B, state the mixing ratios by using semicolons, as in (V_A; V_B)
- The preferred metrics is the volume ratios. If that is not available, mass or mol ratios can be used instead, but it the analysis the mixing ratios will be assumed to be based on volumes.

Example:

1
4; 1 | 1
1 >> 5; 2; 0.3 | 2; 1

Add. lay. Fronside. Deposition. Solvents. Supplier [Sup.1; Sup.2 >> Sup.3; ... >> ... | Sup.4 >> ... | Sup.5 | ...]

Format: Text string



Default: 'Unknown'
Description: The suppliers of all the solvents.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- For non-liquid processes with no solvents, mark the supplier as 'none'
- If the supplier for a solvent is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Sigma Aldrich
Sigma Aldrich; Fisher | Acros
none >> Sigma Aldrich; Sigma Aldrich | Unknown

Add. lay. Fronside. Deposition. Solvents. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]

Format: Text string
Default: 'Unknown'
Description: The purity of the solvents used.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the solvent purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solvent is a mixture of different solvents, e.g. A and B, list the associated purities and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For non-liquid processes with no solvents, state the purity as 'none'
- If the purity for a solvent is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
Puris; Puris | Tecnical
none >> Pro analysis; Pro analysis | Unknown

Add. lay. Fronside. Deposition. Reaction solutions. Compounds [C1; C2 >> C3; … >> … | C4; C5 | C6 | …]

Format: Text string
Default: nan
Description: The non-solvent precursor chemicals used in each reaction step

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the non-solvent chemicals associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several compounds, e.g. A and B, list the associated compounds in alphabetic order and separate them with semicolons, as in (A; B)
- Note that also dopants/additives should be included

- When several precursor solutions are made and mixed before the reaction step, it is the properties of the final mixture used in the reaction we here describe.
- The number and order of layers and reaction steps must line up with the previous columns.
- For gas phase reactions, state the reaction gases as if they were in solution.
- For solid-state reactions, state the compounds as if they were in solution.
- For reaction steps involving only pure solvents, state this as 'none'
- If the compounds for a deposition step is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

FK209; Li-TFSI; Spiro-MeOTAD; TBP
NiO-np
PTAA | CuSCN

Add. lay. Fronside. Deposition. Reaction solutions. Compounds. Supplier [Sup.1; Sup.2 >> Sup.3; … >> … | Sup.4 >> … | Sup.5 | …]

Format: Text string
Default: 'Unknown'
Description: The suppliers of the non-solvent chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the non-solvent chemical suppliers associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, e.g. A and B, list the associated suppliers and separate them with semicolons, as in (A; B)
- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- For gas phase reactions, state the suppliers for the gases or the targets/evaporation sources that are evaporated/sputtered/etc.
- For solid state reactions, state the suppliers for the compounds in the same way.
- For reaction steps involving only pure solvents, state the supplier as 'none' (as that that is entered in a separate filed)
- For chemicals that are lab made, state that as "Lab made" or "Lab made (name of lab)"
- If the supplier for a compound is unknown, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

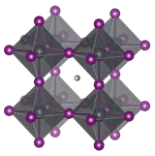
Example:

Dysole; Sigma Aldrich; Dyenamo; Sigma Aldrich
Sigma Aldrich; Fisher | Acros
Lab made (EPFL) | Sigma Aldrich >> none

Add. lay. Fronside. Deposition. Reaction solutions. Compounds. Purity [Pur.1; Pur.2 >> Pur.3; … >> … | Pur.4 >> … | Pur.5 | …]

Format: Text string
Default: 'Unknown'
Description: The purity of the non-solvent chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the compound purities associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, i.e. A and B, list the associated purities and separate them with semicolons, as in (A; B)



- The number and order of layers, reaction steps, and solvents must line up with the previous columns.
- Use standard nomenclature for purities, e.g. pro analysis, puris, extra dry, etc.
- For reaction steps involving only pure solvents, state this as 'none' (as that is stated in another field)
- If the purity for a compound is not known, state this as 'Unknown'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Pro analysis
99.999; Puris | Tecnical
Unknown >> Pro analysis; Pro analysis | none

Add. lay. Fronside. Deposition. Reaction solutions. Concentrations [c1 M; c2 mol/dm3 >> c3 mg/ml; … >> … | c4 wt%; c5 vol% | c6 ppm |…]

Format: Text string
Default: nan
Description: The concentration of the non-solvent precursor chemicals.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the concentrations associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If a solution contains several dissolved compounds, e.g. A and B, list the associated concentrations and separate them with semicolons, as in (A; B)
- The order of the compounds must be the same as in the previous filed.
- For reaction steps involving only pure solvents, state this as 'none'
- When concentrations are unknown, state that as 'nan'
- Concentrations can be stated in different units suited for different situations. Therefore, specify the unit used. When possible, use one of the preferred units:
    - M, mM, molal; g/ml, mg/ml, µg/ml, wt%, mol%, vol%, ppt, ppm, ppb
- For values with uncertainties, state the best estimate, e.g. write 4 wt% and not 3-5 wt%.

Example:

4 wt%
0.2 M; 0.15 M| 10 mg/ml
0.3 mol% | 2 mol%; 0.2 wt% | nan

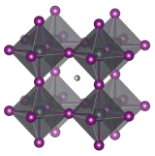
Add. lay. Fronside. Deposition. Reaction solutions. Volumes [V1 >> V2 >> … | V3 >> … | V4 | …] [ml]

Format: Text string
Default: nan
Description: The volume of the reaction solutions

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the volumes associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- The volumes refer the volumes used, not the volume of the stock solutions. Thus if 0.15 ml of a solution is spin-coated, the volume is 0.15 ml
- For reaction steps without solvents, state the volume as 'nan'
- When volumes are unknown, state that as 'nan'

Example:

0.1
0.1 >> 0.05 | 0.05
nan | 0.15



Add. lay. Fronside. Deposition. Reaction solutions. Age [A1 >> A2 >> … | A3 >> … | A4 | …] [h]

Format: Text string
Default: nan
Description: The age of the solutions

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the age of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- As a general guideline, the age refers to the time from the preparation of the final precursor mixture to the reaction procedure.
- When the age of a solution is not known, state that as ‘nan’
- For reaction steps where no solvents are involved, state this as ‘nan’
- For solutions that are stored a long time, an order of magnitude estimate is adequate.

Example:

2
0.25 |1000 >> 10000
nan | nan

Add. lay. Fronside. Deposition. Reaction solutions. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the reaction solutions.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the temperatures of the solutions associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- If a reaction solution undergoes a temperature program, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons, e.g. 25; 100
- When the temperature of a solution is unknown, state that as ‘nan’
- For reaction steps where no solvents are involved, state the temperature of the gas or the solid if that make sense. Otherwise state this as ‘nan’
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- Assume an undetermined room temperature to be 25

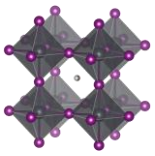
Example:

25
100; 50 | 25
nan | 25 >> 25

Add. lay. Fronside. Deposition. Substrate. Temperature [T1; T2 >> T3; … >> … | T4 >> … | T5 | …] [deg. C]

Format: Text string
Default: nan
Description: The temperature of the substrate.

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (‘ | ‘)
- When more than one reaction step, separate the temperatures of the substrates (i.e. the last deposited layer) associated to each reaction step by a double forward angel bracket with one blank space on both sides (‘ >> ‘)
- The temperature of the substrate refers to the temperature when the deposition of the layer is occurring.
- If a substrate undergoes a temperature program before the deposition, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)



- When the temperature of a substrate is not known, state that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- Assume that an undetermined room temperature is 25

Example:

25
nan
125; 325; 375; 450 | 25 >> 25

Add. lay. Fronside. Deposition. Thermal annealing. Temperature [T1; T2 >> T3; ... >> ... | T4 >> ... | T5 | ...] [deg. C]

Format: Text string

Default: nan

Description: The temperatures of the thermal annealing program associated with depositing the layers

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the annealing temperatures associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the temperatures (e.g. start, end, and other important points) and separate them with semicolons (e.g. 25; 100)
- For values with uncertainties, state the best estimate, e.g. write 120 and not 110-130.
- If no thermal annealing is occurring after the deposition of a layer, state that by stating the room temperature (assumed to 25°C if not further specified)
- If the thermal annealing program is not known, state that by 'nan'

Example:

25
50 | nan
450 | 125; 325; 375; 450 >> 125; 325; 375; 450

Add. lay. Fronside. Deposition. Thermal annealing. Time [t1; t2 >> t3; ... >> ... | t4 >> ... | t5 | ...] [min]

Format: Text string

Default: nan

Description: The time program associated to the thermal annealing program.

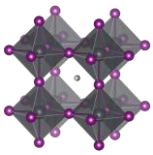
- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the annealing times associated to each reaction step by a double forward angel bracket with one blank space on both sides (' >> ')
- If the thermal annealing involves a temperature program with multiple temperature stages, list the associated times at those temperatures and separate them with semicolons.
- The annealing times must align in terms of layers, reaction steps and annealing temperatures in the previous filed.
- If a time is not known, state that by 'nan'
- If no thermal annealing is occurring after the deposition of a layer, state that by 'nan'
- For values with uncertainties, state the best estimate, e.g. write 20 and not 10-30.

Example:

nan
60 | 1000
30 | 5; 5; 5; 30 >> 5; 5; 5; 30

Add. lay. Fronside. Deposition. Thermal annealing. Atmosphere [Gas1; Gas2 >> Gas3; ... >> ... | Gas4 >> ... | Gas5 | ...]

Format: Text string



Default: "Unknown"
Description: The atmosphere during thermal annealing

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- When more than one reaction step, separate the atmospheres associated to each annelaing step by a double forward angel bracket with one blank space on both sides (' >> ')
- The number and order of layers and deposition steps must line up with the previous columns.
- If the atmosphere is a mixture of different gases, i.e. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas.
- This is often the same as the atmosphere under which the deposition is occurring, but not always.
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

N2
Vacuum | N2
Air | Ar >> Ar

Add. lay. Fronside. Storage. Time until next deposition step [h]

Format: Float
Default: nan
Description: The time between the back contact is finalised and the next layer is deposited

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.
- If this is the last layer in the stack, state this as 'nan'

Add. lay. Fronside. Storage. Atmosphere [Gas1; Gas2; ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere in which the sample with the finalised back contact is stored until the next deposition step or device performance measurement
Example:

Air
N2
Vacuum

Add. lay. Fronside. Storage. Relative humidity [%]

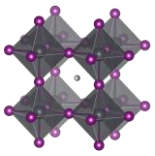
Format: Float
Default: nan
Description: The relive humidity under which the sample with the finalised back contact is stored until the next deposition step or device performance measurement

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.

Add. lay. Fronside. Surface treatment before next deposition step

Format: Text string
Default: nan
Description: Description of any type of surface treatment or other treatment the sample with the finalised back contact is stored until the next deposition step or device performance measurement

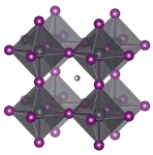
- If more than one treatment, list the treatments and separate them by a double forward angel bracket (' >> ')
- If no special treatment, state that as 'none'



- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

none
Ar plasma
UV-ozone



Additional layers. Backcontact side

The instructions for additional layers on the backside are identical to the instructions for the additional layers on het frontside.

Encapsulation [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell is encapsulated

Encapsulation. Stack sequence [Mat.1; Mat.2; … | Mat.3; … | Mat.4 | …]

Format: Text string
Default: "Unknown"
Description: The stack sequence of the encapsulation

- Every layer should be separated by a space, a vertical bar, and a space, i.e. (' | ')
- If two materials, e.g. A and B, are mixed in one layer, list the materials in alphabetic order and separate them with semicolons, as in (A; B)
- Use common abbreviations when appropriate but spell it out if risk for confusion.
- There are now separate filed for doping. Indicate doping with colons. E.g. wither aluminium doped NiO-np as Al:NiO-np

Example:

SLG
Epoxy
Cover glass
PMMA

Encapsulation. Edge sealing materials [Mat.1; Mat.2; …]

Format: Text string
Default: "Unknown"
Description: Edge sealing materials

- If two materials, e.g. A and Bare used, list the materials in alphabetic order and separate them with semicolons, as in (A; B)

Example:

Epoxy
Surlyn
UV-glue

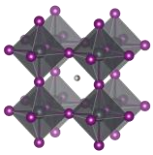
Encapsulation. Atmosphere for encapsulation [Gas1; Gas2; …]

Format: Text string
Default: "Unknown"
Description: The surrounding atmosphere during encapsulation.

- If the surrounding atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas

Example:

N2
Vacuum
Air



Encapsulation. Water vapour transmission rate [g/m^2/d]

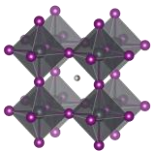
Format: Float
Default: nan
Description: The water vapour transmission rate trough the encapsulation.

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.

Encapsulation. Oxygen transmission rate [cm^3/m^2/d]

Format: Float
Default: nan
Description: The oxygen transmission rate trough the encapsulation.

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.



JV data

JV. Measured [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if IV-data has been measured and is reported.

JV. Average over N number of cells

Format: Integer
Default: 0
Description: The number of cells the reported IV data is based on.

- The preferred way to enter data is to give every individual cell its own entry in the data template/data base. If that is done, the data is an average over 1 cell.
- If the reported IV data is not the data from one individual cell, but an average over N cells. Give the number of cells.
- If the reported value is an average, but it is unknown over how many cells the value has been averaged (and no good estimate is available), state the number of cells as 2, which is the smallest number of cells that qualifies for an averaging procedure.

JV. Certified values [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the IV data is measured by an independent and certification institute. If your solar simulator is calibrated by a calibrated reference diode, that does **not** count as a certified result.

JV. Certification Institute

Format: Text string
Default: Empty text string
Description: The name of the certification institute that has measured the certified device.
Example:

Newport
NIM, National Institute of Metrology of China
KIER, Korea Institute of Energy Research

JV. Storage. Age of cell [days]

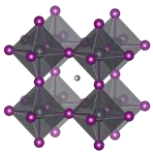
Format: Float
Default: nan
Description: The age of the cell with respect to when the last deposition step was finalised.

- If there are uncertainties, only state the best estimate, e.g. write 3 and not 1-5.

JV. Storage. Atmosphere [Gas1; Gas2; ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere in which the sample was stored between the device finalisation and the IV measurement.

- If the atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas
- If the atmosphere has changed during the storing time, separate the different atmospheres by a double forward angel bracket with one blank space on both sides (' >> ')



- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

N2
Air
N2 >> Air

JV. Storage. Relative humidity [%]

Format: Text string
Default: nan
Description: The relative humidity in the atmosphere in which the sample was stored between the device finalisation and the IV measurement.

- If the relative humidity has changed during the storing time, separate the different relative humidity by a double forward angel bracket with one blank space on both sides (' >> ')
- If the relative humidity is not known, stat that as 'nan'
- For values with uncertainties, state the best estimate, e.g. write 35 and not 30-40.

Example:

35
0
0 >> 25

JV. Test. Atmosphere [Gas1; Gas2; ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere in which the IV measurement is conducted

- If the atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas

Example:

Air
N2
Vacuum

JV. Test. Relative humidity [%]

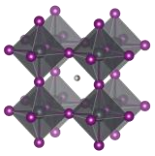
Format: Float
Default: nan
Description: The relive humidity in which the IV measurement is conducted

- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.
- If the relative humidity is not known, stat that as 'nan'

JV. Test. Temperature [deg. C]

Format: Float
Default: nan
Description: The temperature of the device during the IV-measurement

- If the temperature is not controlled and not is known, assume a standard room temperature of 25°C.
- If there are uncertainties, only state the best estimate, e.g. write 35 and not 20-50.



JV. Light source. Type [Dark/White LED/Metal halide/ ...]

Format: Text string
Default: Empty text string
Description: The type of light source used during the IV-measurement

- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.
- The category Solar simulator should only be used when you do not really know which type of light source you have in your solar simulator.

Example:

Laser
Metal halide
Outdoor
Solar simulator
Sulfur plasma
White LED
Xenon plasma

JV. Light source. Brand name

Format: Text string
Default: Empty text string
Description: The brand name and model number of the light source/solar simulator used

- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Newport model 91192
Newport AAA
Atlas suntest

JV. Light source. Simulator class

Format: Text string
Default: Empty text string
Description: The class of the solar simulator

- A three-letter code of As, Bs, and Cs. The order of the letters represents the quality of: spectral match, spatial non-uniformity, and temporal instability

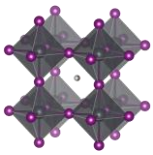
Example:

AAA
ABB
CAB

JV. Light. Intensity [mW/cm^2]

Format: Float
Default: nan
Description: The light intensity during the IV measurement

- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- Standard AM 1.5 illumination correspond to 100 mW/cm^2
- If you need to convert from illumination given in lux; at 550 nm, 1 mW/cm^2 corresponds to 6830 lux. Be aware that the conversion change with the spectrum used. As a rule of thumb for general fluorescent/LED light sources, around 0.31mW corresponded to 1000 lux. If your light intensity is measured in lux, it probably means that your light spectra deviates quite a lot from AM 1.5, wherefore it is *very* important that you also specify the light spectra in the next column.



JV. Light. Spectra [AM 1.5/UVA/UVB/Monochromatic/ …]

Format: Text string
Default: Empty text string
Description: The light spectrum used (or simulated as best as possible) during the IV measurement
Example:

AM 1.0
AM 1.5
Indoor light
Monochromatic
Outdoor
UV

JV. Light. Wavelength range [lambda min; lambda max] or [lambda constant] [nm]

Format: Text string
Default: Empty text string
Description: The wavelength range of the light source

- Separate the lower and upper bound by a semicolon.
- For monochromatic light sources, only give the constant value.
- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- State unknown values as 'nan'

Example:

330; 1000
400; nan
550

JV. Light. Illumination direction [Substrate/superstrate]

Format: Text string
Default: Empty text string
Description: The direction of the illumination with respect to the device stack

- If the cell is illuminated trough the substrate, state this as 'Substrate'
- If the cell is illuminated trough the top contact, state this as 'Superstrate'
- For back contacted cells illuminated from the non-contacted side, state this as 'Superstrate'

Example:

Substrate
Superstrate

JV. Light. Masked cell [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the cell is illuminated trough a mask with an opening that is smaller than the total cell area.

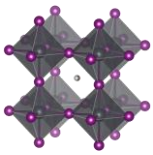
JV. Light. Mask area [cm^2]

Format: Float
Default: nan
Description: The area of the opening in the mask trough with the cell is illuminated (if there is a mask)

- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- If there is no light mask, leave this field empty.

JV. Scan. Speed [mV/s]

Format: Float



Default: nan
Description: The speed of the potential sweep during the IV measurement

JV. Scan. Delay time [ms]

Format: Float
Default: nan
Description: The time at each potential value before integration in the potential sweep.

- For some potentiostats you need to specify this value, whereas for others it is set automatically and is not directly accessible.
- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- If unknown, leave this field empty.

JV. Scan. Integration time [ms]

Format: Float
Default: nan
Description: The integration time at each potential value in the potential sweep.

- For some potentiostats you need to specify this value, whereas for others it is set automatically and is not directly accessible.
- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- If unknown, leave this field empty.

JV. Scan. Voltage step [mV]

Format: Float
Default: nan
Description: The distance between the measurement point in the potential sweep

- If unknown, leave this field empty.

JV. Preconditioning. Protocol [none/Light soaking/Potential biasing/ …]

Format: Text string
Default: Empty text string
Description: Any preconditioning protocol done immediately before the IV measurement

- If no preconditioning was done, state this as 'none'
- If more than one preconditioning protocol was conducted in parallel, separate them with semicolons
- If more than one preconditioning protocol was conducted in sequence, separate them by a double forward angel bracket (' >> ')

Example:

Cooling
Heeting
Light soaking
Light soaking; Potential biasing
Potential biasing

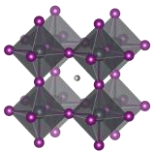
JV. Preconditioning. Time [s]

Format: Float
Default: nan
Description: The duration of the preconditioning protocol

- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- If unknown or not applicable, leave this field empty.

JV. Preconditioning. Potential [V]

Format: Float



Default: nan
Description: The potential at any potential biasing step

- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- If unknown or not applicable, leave this field empty.

JV. Preconditioning. Light intensity [mW/cm^2]

Format: Float
Default: nan
Description: The light intensity at any light soaking step

- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- If unknown or not applicable, leave this field empty.

JV. Reverse scan. Voc [V]

Format: Float
Default: nan
Description: The open circuit potential, Voc, at the reverse voltage sweep (when U scanned from Voc to 0)

- Give Voc in volts [V]
- If there are uncertainties, only state the best estimate, e.g. write 1.03 and not 1.01-1.05
- If unknown or not applicable, leave this field empty.

JV. Reverse scan. Jsc [mA/cm^2]

Format: Float
Default: nan
Description: The short circuit current, Jsc, at the reverse voltage sweep (when U scanned from Voc to 0)

- Give Jsc in mA/cm^2
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

JV. Reverse scan. FF [number between 0 and 1]

Format: Float
Default: nan
Description: The fill factor, FF, at the reverse voltage sweep (when U scanned from Voc to 0)

- Give FF as the ratio between Vmp*Jmp/(Voc*Jsc) which gives it a value between 0 and 1
- If there are uncertainties, only state the best estimate, e.g. write 0.73 and not 0.7-0.76
- If unknown or not applicable, leave this field empty.

JV. Reverse scan. PCE [%]

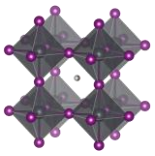
Format: Float
Default: nan
Description: The efficiency, PCE, at the reverse voltage sweep (when U scanned from Voc to 0)

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

JV. Reverse scan. Vmp [V]

Format: Float
Default: nan
Description: The potential at the maximum power point, Vmp, at the reverse voltage sweep (when U scanned from Voc to 0)

- Give Vmp in volts [V]
- If there are uncertainties, only state the best estimate, e.g. write 1.03 and not 1.01-1.05
- If unknown or not applicable, leave this field empty.



JV. Reverse scan. Jmp [mA/cm^2]
Format: Float
Default: nan
Description: The current density at the maximum power point, Jmp, at the reverse voltage sweep (when U scanned from Voc to 0)

- Give Jmp in mA/cm²
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

JV. Reverse scan. Series resistance [ohmcm^2]
Format: Float
Default: nan
Description: The series resistance as extracted from the reverse voltage sweep (when U scanned from Voc to 0)

JV. Reverse scan. Shunt resistance [ohmcm^2]
Format: Float
Default: nan
Description: The shunt resistance as extracted from the reverse voltage sweep (when U scanned from Voc to 0)

JV. Forward scan. Voc [V]
Format: Float
Default: nan
Description: The open circuit potential, Voc, at the forward voltage sweep (when U scanned from 0 to Voc)

- Give Voc in volts [V]
- If there are uncertainties, only state the best estimate, e.g. write 1.03 and not 1.01-1.05
- If unknown or not applicable, leave this field empty.

JV. Forward scan. Jsc [mA/cm^2]
Format: Float
Default: nan
Description: The short circuit current, Jsc, at the forward voltage sweep (when U scanned from 0 to Voc)

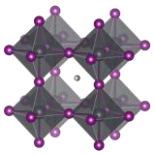
- Give Jsc in mA/cm²
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

JV. Forward scan. FF [number between 0 and 1]
Format: Float
Default: nan
Description: The fill factor, FF, at the forward voltage sweep (when U scanned from 0 to Voc)

- Give FF as the ratio between Vmp*Jmp/(Voc*Jsc) which gives it a value between 0 and 1
- If there are uncertainties, only state the best estimate, e.g. write 0.73 and not 0.7-0.76
- If unknown or not applicable, leave this field empty.

JV. Forward scan. PCE [%]
Format: Float
Default: nan
Description: The efficiency, PCE, at the forward voltage sweep (when U scanned from 0 to Voc)

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20



- If unknown or not applicable, leave this field empty.

JV. Forward scan. Vmp [V]

Format: Float
Default: nan
Description: The potential at the maximum power point, Vmp, at the forward voltage sweep (when U scanned from 0 to Voc)

- Give Vmp in volts [V]
- If there are uncertainties, only state the best estimate, e.g. write 1.03 and not 1.01-1.05
- If unknown or not applicable, leave this field empty.

JV. Forward scan. Jmp [mA/cm^2]

Format: Float
Default: nan
Description: The current density at the maximum power point, Jmp, at the forward voltage sweep (when U scanned from 0 to Voc)

- Give Jmp in mA/cm^2
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

JV. Forward scan. Series resistance [ohmcm^2]

Format: Float
Default: nan
Description: The series resistance as extracted from the forward voltage sweep (when U scanned from 0 to Voc)

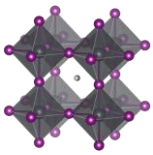
JV. Forward scan. Shunt resistance [ohmcm^2]

Format: Float
Default: nan
Description: The shunt resistance as extracted from the forward voltage sweep (when U scanned from 0 to Voc)

JV. Link. Raw data

Format: Text string
Default: Empty text string
Description: A link to where the data file for the IV-data is stored

- This is a beta feature. The plan is to create a file repository where the raw files for IV data can be stored and disseminated. With the link and associated protocols, it should be possible to programmatically access and analyse the raw IV-data.



Stabilised efficiencies

Stabilised performance. Measured [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if a stabilised cell efficiency has been measured

- A stabilised efficiency requires a continuous measurement. Measuring an IV-curve, storing the cell in the dark for a while, and then measure a new IV-curve does thus not count as a stabilised efficiency measurement.

Stabilised performance. Procedure [MPPT/Constant potential/Constant current/ ...]

Format: Text string
Default: Empty text string
Description: The Potentiostatic load condition during the stabilised performance measurement
Examples:

Constant current
Constant potential
MPPT
Passive resistance
Short circuit

Stabilised performance. Procedure. Metrics [Potential in V, Current in mA/cm^2, ...]

Format: Text string
Default: Empty text string
Description: The metrics associated to the load condition in the previous filed

- For measurement under constant current, state the current in mA/cm^2
- For measurement under constant potential. State the potential in V
- For a measurement under constant resistive load, state the resistance in ohm

Stabilised performance. Measurement time [min]

Format: Float
Default: nan
Description: The duration of the stabilised performance measurement.

Stabilised performance. PCE [%]

Format: Float
Default: nan
Description: The stabilised efficiency, PCE

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

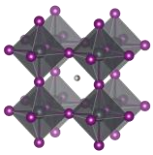
Stabilised performance. Vmp [V]

Format: Float
Default: nan
Description: The stabilised Vmp

- Give Vmp in volts [V]
- If there are uncertainties, only state the best estimate, e.g. write 1.03 and not 1.01-1.05
- If unknown or not applicable, leave this field empty.

Stabilised performance. Jmp [mA/cm^2]

Format: Float



Default: nan
Description: The stabilised Jmp

- Give Jmp in mA/cm²
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Stabilised performance. Link. Raw data

Format: Text string
Default: Empty text string
Description: A link to where the data file for the stability measurement is stored

- This is a beta feature. The plan is to create a file repository where the raw files for IV data can be stored and disseminated. With the link and associated protocols, it should be possible to programmatically access and analyse the raw IV-data.

Quantum efficiency

EQE. Measured [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the external quantum efficiency has been measured

EQE. Light bias [mW/cm^2]

Format: Float
Default: nan
Description: The light intensity of any bias light during the EQE measurement

- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- If unknown or not applicable, leave this field empty.

EQE. Integrated Jsc [mA/cm^2]

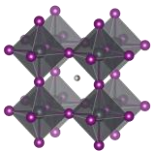
Format: Float
Default: nan
Description: The integrated current from the EQE measurement

- Give Jmp in mA/cm²
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

EQE. Link. Raw data

Format: Text string
Default: Empty text string
Description: A link to where the data file for the EQE measurement is stored

- This is a beta feature. The plan is to create a file repository where the raw files for IV data can be stored and disseminated. With the link and associated protocols, it should be possible to programmatically access and analyse the raw IV-data.



Stability

Stability. Measured [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if some kind of stability measurement has been done.

- There is no sharp boundary between a stability measurement and a measurement of stabilised efficiency. Generally, a measurement under a few minutes is considered as a measurement of stabilised efficiency, whereas a stability measurement is sufficiently long for degradation to be seen (unless the device is really good)

Stability. Protocol [ISOS x/IEC x/ ...]

Format: Text string
Default: Empty text string
Description: The stability protocol used for the stability measurement.

- For a more detailed discussion on protocols and standard nomenclature for stability measurements, please see the following paper:
    - Consensus statement for stability assessment and reporting for perovskite photovoltaics based on ISOS procedures by: M. V. Khenkin et al. Nat. Energ. 2020. DOI: 10.1038/s41560-019-0529-5

Example:

ISOS-D-1
ISOS-D-1I
ISOS-L-2
ISOS-T-3
IEC 61215

Stability. Average over N number of cells

Format: Integer
Default: 1
Description: The number of cells the reported stability data is based on.

- The preferred way to enter data is to give every individual cell its own entry in the data template/data base. If that is done, the data is an average over 1 cell.
- If the reported stability data is not the data from one individual cell, but an average over N cells. Give the number of cells.
- If the reported value is an average, but it is unknown over how many cells the value has been averaged (and no good estimate is available), state the number of cells as 2, which is the smallest number of cells that qualifies for an averaging procedure.

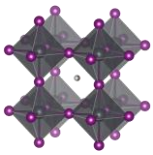
Stability. Light source. Type [Dark/White LED/Metal halide/ ...]

Format: Text string
Default: Empty text string
Description: The type of light source used during the stability measurement

- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Laser
Metal halide
Outdoor
Solar simulator
Sulfur plasma
White LED



Xenon plasma

Stability. Light. Intensity [mW/cm^2]

Format: Float
Default: nan
Description: The light intensity during the stability measurement

- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- Standard AM 1.5 illumination correspond to 100 mW/cm^2
- If you need to convert from illumination given in lux; at 550 nm, 1 mW/cm^2 corresponds to 6830 lux

Stability. Light. Spectra [AM 1.5/UVA/UVB/Monochromatic/ …]

Format: Text string
Default: Empty text string
Description: The light spectrum used (or simulated as best as possible) during the stability measurement

- For an unspecified light spectra (that not is dark), state this as 'Light'

Example:

AM 1.0
AM 1.5
Indoor light
Monochromatic
Outdoor
UV

Stability. Light. Wavelength range [lambda min; lambda max] or [lambda constant] [nm]

Format: Text string
Default: Empty text string
Description: The wavelength range of the light source

- Separate the lower and upper bound by a semicolon.
- For monochromatic light sources, only give the constant value.
- If there are uncertainties, only state the best estimate, e.g. write 100 and not 90-100.
- State unknown values as 'nan'

Example:

330; 1000
400; nan
550

Stability. Light. Illumination direction [Substrate/superstrate]

Format: Text string
Default: Empty text string
Description: The direction of the illumination with respect to the device stack

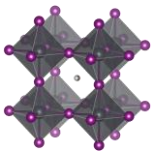
- If the cell is illuminated trough the substrate, state this as 'Substrate'
- If the cell is illuminated trough the top contact, state this as 'Superstrate'
- For back contacted cells illuminated from the non-contacted side, state this as 'Superstrate'

Example:

Substrate
Superstrate

Stability. Light. Load condition [Continious/Cycled/Day-nigh/ …]

Format: Text string



Default: Empty text string
Description: The load situation of the illumination during the stability measurement.

- If the illumination is constant during the entire stability measurement, or if the cell is stored in the dark, state this as 'Constant'.
- If the situation periodically is interrupted by IV-measurements, continue to consider the load condition as constant
- If there is a cycling between dark and light, state this as 'Cycled'
- If the illumination varies in an uncontrolled way, state this as 'Uncontrolled'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Constant
Cycled
Day-Night cycle
Uncontrolled

Stability. Light. Cycling times [time in low light; time in high light] [h]

Format: Text string
Default: 'nan; nan'
Description: If the illumination load is cycled during the stability measurement, state the time in low light followed by the time in high light for the cycling period.

- If not applicable, leave blank

Example:

12; 12
6; 10
nan; nan

Stability. Light. UV filter [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if a UV-filter of any kind was placed between the illumination source and the device during the stability measurement.

Stability. Potential bias. Load condition [Open circuit/MPPT/Constant potential/ …]

Format: Text string
Default: Empty text string
Description: The Potentiostatic load condition during the stability measurement

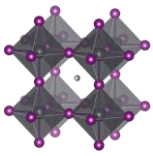
- When the cell is not connected to anything, state this as 'Open circuit'

Examples:

Constant current
Constant potential
MPPT
Open circuit
Passive resistance
Short circuit

Stability. Potential bias. Range [U.min; U.max] or [U.constant] [V]

Format: Text string
Default: Empty text string
Description: The potential range during the stability measurement



- Separate the lower and upper bound by a semicolon.
- For constant values, state only that value.
- For open circuit conditions, state this as 'nan'
- If there are uncertainties, only state the best estimate, e.g. write 1 and not 0.90-1.1
- State unknown values as 'nan'

Example:

0.9; 1.02
1.5
nan

Stability. Potential bias. Passive resistance [ohm]

Format: Float
Default: nan
Description: The passive resistance in the measurement circuit if a resistor was used

- Give the value in ohm
- If there are uncertainties, only state the best estimate, e.g. write 1.03 and not 1.01-1.05
- If unknown or not applicable, leave this field empty.

Stability. Temperature. Load condition [Constant/Uncontrolled/Cycled/ ...]

Format: Text string
Default: Empty text string
Description: The load situation of the temperature during the stability measurement.

- If the temperature is constant during the entire stability measurement, state this as 'Constant'.
- If there is a cycling between colder and hotter conditions, state this as 'Cycled'
- If the temperature varies in an uncontrolled way, state this as 'Uncontrolled'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Constant
Uncontrolled
Cycled

Stability. Temperature. Range [T.min; T.max] or [T.constant] [deg. C]

Format: Text string
Default: Empty text string
Description: The temperature range during the stability measurement

- Separate the lower and upper bound by a semicolon.
- For constant values, state only that value.
- If there are uncertainties, only state the best estimate, e.g. write 1 and not 0.90-1.1
- State unknown values as 'nan'

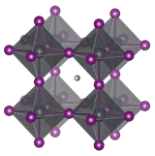
Example:

30
25; 85
nan

Stability. Temperature. Cycling times [t at T.min; t at T.max] [h]

Format: Text string
Default: Empty text string
Description: If the temperature is cycled during the stability measurement, state the time in low temperature followed by the time in high temperature for the cycling period.

- If not applicable, leave blank



- Separate the lower and upper bound by a semicolon.
- If there are uncertainties, only state the best estimate, e.g. write 1 and not 0.90-1.1
- State unknown values as 'nan'

Example:

2; 2
0.5; 10

Stability. Temperature. Ramp speed [deg. C/min]

Format: Float
Default: nan
Description: The temperature ramp speed

- If there are uncertainties, only state the best estimate, e.g. write 1.03 and not 1.01-1.05
- If unknown or not applicable, leave this field empty.

Stability. Atmosphere [Gas1; Gas2; ...]

Format: Text string
Default: "Unknown"
Description: The atmosphere in which the stability measurement is conducted

- If the atmosphere is a mixture of different gases, e.g. A and B, list the gases in alphabetic order and separate them with semicolons, as in (A; B)
- "Dry air" represents air with low relative humidity but where the relative humidity is not known
- "Ambient" represents air where the relative humidity is not known. For ambient conditions where the relative humidity is known, state this as "Air"
- "Vacuum" (of unspecified pressure) is for this purpose considered as an atmospheric gas

Example:

Air
N2
Vacuum

Stability. Atmosphere. Oxygen concentration [%]

Format: Float
Default: nan
Description: The oxygen concentration in the atmosphere

- If unknown, leave this field empty.

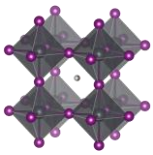
Stability. Relative humidity. Load conditions [Ambient/Controlled/Cycled/ ...]

Format: Text string
Default: Empty text string
Description: The load situation of the relative humidity during the stability measurement.

- If the relative humidity is constant during the entire stability measurement, state this as 'Constant'.
- If there is a cycling between dryer and damper conditions, state this as 'Cycled'
- If the relative humidity varies in an uncontrolled way, i.e. the cell is operated under ambient conditions, state this as 'Ambient'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Ambient
Controlled
Cycled



Stability. Relative humidity. Range [RH.min; RH.max] [%]

Format: Text string
Default: Empty text string
Description: The relative humidity range during the stability measurement

- Separate the lower and upper bound by a semicolon.
- For constant values, state only that value.
- If there are uncertainties, only state the best estimate, e.g. write 1 and not 0.90-1.1
- State unknown values as 'nan'

Example:

45
35; 65
nan

Stability. Relative humidity. Average value [%]

Format: Float
Default: nan
Description: The average relative humidity during the stability measurement.

- If there are uncertainties, only state the best estimate, e.g. write 1 and not 0.90-1.1
- If unknown, leave this field empty.

Stability. Time. Total exposure [h]

Format: Float
Default: nan
Description: The total duration of the stability measurement.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050

Stability. Periodic JV measurements [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the stability measurement periodically is interrupted for JV-measurements. A typical example is a cell that is stored in the dark and once in a wile is take out from storage for an IV-measurement.

Stability. Periodic JV measurements. Time between measurements [h]

Format: Float
Default: nan
Description: The average time between JV-measurement during the stability measurement.

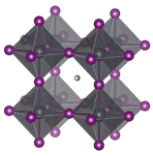
Stability. PCE. Initial value [%]

Format: Float
Default: nan
Description: The efficiency, PCE, of the cell before the stability measurement routine starts

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Stability. PCE. Burn in observed [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the performance has a relatively fast initial decay after which the decay rate stabilises at a lower level.



- There is no sharp boundary between an initial burn in phase and a catastrophic failure, but if the performance of the cell quickly degrade by more than half, it is stretching it a bit to label this as an initial burn in phase.

Stability. PCE. End of experiment [% of initial PCE]

Format: Float
Default: nan
Description: The efficiency, PCE, of the cell at the end of the stability routine

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Stability. PCE. T95 [h]

Format: Float
Default: nan
Description: The time after which the cell performance has degraded by 5 % with respect to the initial performance.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050
- If unknown or not applicable, leave this field empty.

Stability. PCE. Ts95 [h]

Format: Float
Default: nan
Description: The time after which the cell performance has degraded by 5 % with respect to the performance after any initial burn in phase.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050
- If unknown or not applicable, leave this field empty.

Stability. PCE. T80 [h]

Format: Float
Default: nan
Description: The time after which the cell performance has degraded by 20 % with respect to the initial performance.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050
- If unknown or not applicable, leave this field empty.

Stability. PCE. Ts80 [h]

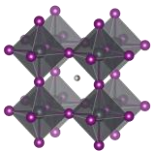
Format: Float
Default: nan
Description: The time after which the cell performance has degraded by 20 % with respect to the performance after any initial burn in phase.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050
- If unknown or not applicable, leave this field empty.

Stability. PCE. Te80 [h]

Format: Float
Default: nan
Description: An estimated T80 for cells that were not measured sufficiently long for them to degrade by 20 %. with respect to the initial performance.

- This value will by definition have a significant uncertainty to it, as it is not measured but extrapolated under the assumption linearity but without a detailed and stabilised extrapolation protocol. This estimate is, however, not without value as it enables a rough comparison between all cells for with the stability has been measured.



- If there is an experimental T80, leave this field empty.

Stability. PCE. Tse80 [h]
Format: Float
Default: nan
Description: An estimated T80s for cells that was not measured sufficiently long for them to degrade by 20 %. with respect to the performance after any initial burn in phase.

- This value will by definition have a significant uncertainty to it, as it is not measured but extrapolated under the assumption linearity but without a detailed and stabilised extrapolation protocol. This estimate is, however, not without value as it enables a ruff comparison between all cells for with the stability has been measured.
- If there is an experimental T80s, leave this field empty.

Stability. PCE. After 1000 h [% of initial PCE]
Format: Float
Default: nan
Description: The efficiency, PCE, of the cell after 1000 hours

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Stability. Lifetime energy yield [kWh/m^2]
Format: Float
Default: nan
Description: The lifetime energy yield

- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Stability. Flexible cell. Number of bending cycles
Format: Integer
Default: 0
Description: Number of bending cycles for a flexible cell in a mechanical stability test

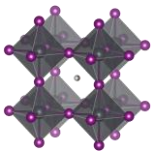
Stability. Flexible cell. Bending radius [degrees]
Format: Float
Default: nan
Description: The bending radius of the flexible cell during the mechanical stability test

Stability. Flexible cell. PCE. Initial value [%]
Format: Float
Default: nan
Description: The efficiency, PCE, of the cell before the mechanical stability measurement routine starts

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Stability. Flexible cell. PCE. End of experiment [% of initial PCE]
Format: Float
Default: nan
Description: The efficiency, PCE, of the cell after the mechanical stability measurement routine

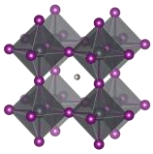
- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.



Stability. Link. Raw data for stability trace

Format: Text string
Default: Empty text string
Description: A link to where the data file for the stability data is stored

- This is a beta feature. The plan is to create a file repository where the raw files for stability data can be stored and disseminated. With the link and associated protocols, it should be possible to programmatically access and analyse the raw stability data.



Outdoor testing

Outdoor. Tested [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the performance of the cell has been tested outdoors.

Outdoor. Protocol [ISOS x/IEC x/ …]

Format: Text string
Default: Empty text string
Description: The protocol used for the outdoor testing.

- For a more detailed discussion on protocols and standard nomenclature for stability measurements, please see the following paper:
    - Consensus statement for stability assessment and reporting for perovskite photovoltaics based on ISOS procedures by: M. V. Khenkin et al. Nat. Energ. 2020. DOI: 10.1038/s41560-019-0529-5

Example:

IEC 61853-1
ISOS-O-1
ISOS-O-2
ISOS-O-3

Outdoor. Average over N number of cells

Format: Integer
Default: 1
Description: The number of cells the reported outdoor data is based on.
Example:

- The preferred way to enter data is to give every individual cell its own entry in the data template/data base. If that is done, the data is an average over 1 cell.
- If the reported data is not the data from one individual cell, but an average over N cells. Give the number of cells.
- If the reported value is an average, but it is unknown over how many cells the value has been averaged (and no good estimate is available), state the number of cells as 2, which is the smallest number of cells that qualifies for an averaging procedure.

Outdoor. Location. Country [Country]

Format: Text string
Default: Empty text string
Description: The country where the outdoor testing was occurring

- For measurements conducted in space, state this as 'Space International'

Example:

Sweden
Switzerland
Space International

Outdoor. Location. City [City]

Format: Text string
Default: Empty text string
Description: The city where the outdoor testing was occurring

Outdoor. Location. Coordinates [Latitude; Longitude] [decimal degrees]

Format: Text string
Default: 'nan; nan'

Description: The coordinates fort the places where the outdoor testing was occurring.

- Use decimal degrees (DD) as the format.

Example:

59.839116; 17.647979
52.428150; 13.532134

Outdoor. Location. Climate zone [Tropical/Subtropical/Temperate/Cold]

Format: Text string
Default: Empty text string
Description: The climate zone for the places where the outdoor testing was occurring.
Example:

Cold
Desert
Subtropical
Teperate
Tropical

Outdoor. Installation. Tilt [degrees]

Format: Float
Default: 'nan'
Description: The tilt of the installed solar cell.

- A module lying flat on the ground have a tilt of 0
- A module standing straight up has a tilt of 90

Outdoor. Installation. Cardinal direction [degrees]

Format: Float
Default: 'nan'
Description: The cardinal direction of the installed solar cell.

- North is 0
- East is 90
- South is 180
- West is 270

Outdoor. Installation. Number of solar tracking axis [0/1/2]

Format: Integer
Default: 0
Description: The number of tracking axis in the installation.

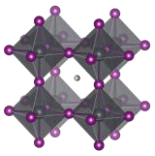
Outdoor. Time. Season [Winter/Summer/ …]

Format: Text string
Default: Empty text string
Description: The time of year the outdoor testing was occurring.

- Order the seasons in alphabetic order and separate them with semicolons.
- For time periods longer than a year, state all four seasons once.

Example:

Autumn
Autumn; Summer
Autumn; Spring, Winter
Autumn; Spring; Summer; Winter
Spring; Winter



Outdoor. Time. Start [year:mm:dd:hh:mm]
Format: Date
Default: Empty string
Format: Year:mm:dd:hh:mm
Description: The starting time for the outdoor measurement.

Outdoor. Time. End [year:mm:dd:hh:mm]
Format: Date
Default: Empty string
Format: Year:mm:dd:hh:mm
Description: The ending time for the outdoor measurement.

Outdoor. Time. Total exposure [days]
Format: Float
Default: nan
Description: The total duration of the outdoor measurement.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050

Outdoor. Potential bias. Load condition [Open circuit/MPPT/Constant potential/ …]
Format: Text string
Default: Empty text string
Description: The Potentiostatic load condition during the outdoor measurement

- When the cell is not connected to anything, state this as 'Open circuit'

Examples:

Constant current
Constant potential
MPPT
Open circuit
Passive resistance
Short circuit

Outdoor. Potential bias. Range [U.min; U.max] or [U.constant] [V]
Format: Text string
Default: Empty text string
Description: The potential range during the outdoor measurement

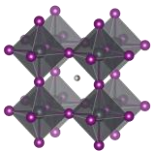
- Separate the lower and upper bound by a semicolon.
- For constant values, state only that value.
- For open circuit conditions, state this as 'nan'
- If there are uncertainties, only state the best estimate, e.g. write 1 and not 0.90-1.1
- State unknown values as 'nan'

Example:

0.9; 1.02
1.5
nan

Outdoor. Potential bias. Passive resistance [ohm]
Format: Float
Default: nan
Description: The passive resistance in the measurement circuit if a resistor was used

- Give the value in ohm
- If there are uncertainties, only state the best estimate, e.g. write 1.03 and not 1.01-1.05



- If unknown or not applicable, leave this field empty.

Outdoor. Temperature. Load condition [Constant/Uncontrolled/Cycled/ ...]

Format: Text string
Default: Empty text string
Description: The load situation of the temperature during the outdoor measurement.

- If the temperature is constant during the entire stability measurement, state this as 'Constant'.
- If there is a cycling between colder and hotter conditions, state this as 'Cycled'
- If the temperature varies in an uncontrolled way, state this as 'Uncontrolled'
- This category was included after the projects initial phase wherefor the list of reported categories is short. Thus, be prepared to expand the given list of alternatives in the data template.

Example:

Constant
Uncontrolled
Cycled

Outdoor. Temperature. Range [T.min; T.max] or [T.constant] [deg. C]

Format: Text string
Default: Empty text string
Description: The temperature range during the outdoor measurement

- Separate the lower and upper bound by a semicolon.
- For constant values, state only that value.
- If there are uncertainties, only state the best estimate, e.g. write 1 and not 0.90-1.1
- State unknown values as 'nan'

Example:

30
-10; 85
nan

Outdoor. Temperature. Tmodule [degrees C]

Format: Float
Default: nan
Description: The effective temperature of the module during peak hours.

Outdoor. Periodic JV measurements [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the outdoor measurement periodically is interrupted for JV-measurements.

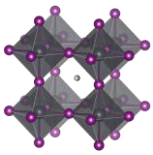
Outdoor. Periodic JV measurements. Time between measurements [h]

Format: Float
Default: nan
Description: The average time between JV-measurement during the outdoor measurement.

Outdoor. PCE. Initial value [%]

Format: Float
Default: nan
Description: The efficiency, PCE, of the cell before the measurement routine starts

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.



Outdoor. PCE. Burn in observed [TRUE/FALSE]
Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if the performance has a relatively fast initial decay after which the decay rate stabilises at a lower level.

Outdoor. PCE. End of experiment [% of initial PCE]
Format: Float
Default: nan
Description: The efficiency, PCE, of the cell at the end of the experiment

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Outdoor. PCE. T95 [h]
Format: Float
Default: nan
Description: The time after which the cell performance has degraded by 5 % with respect to the initial performance.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050
- If unknown or not applicable, leave this field empty.

Outdoor. PCE. Ts95 [h]
Format: Float
Default: nan
Description: The time after which the cell performance has degraded by 5 % with respect to the performance after any initial burn in phase.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050
- If unknown or not applicable, leave this field empty.

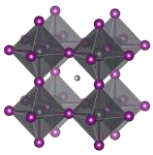
Outdoor. PCE. T80 [h]
Format: Float
Default: nan
Description: The time after which the cell performance has degraded by 20 % with respect to the initial performance.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050
- If unknown or not applicable, leave this field empty.

Outdoor. PCE. Ts80 [h]
Format: Float
Default: nan
Description: The time after which the cell performance has degraded by 20 % with respect to the performance after any initial burn in phase.

- If there are uncertainties, only state the best estimate, e.g. write 1000 and not 950-1050
- If unknown or not applicable, leave this field empty.

Outdoor. PCE. Te80 [h]
Format: Float
Default: nan
Description: An estimated T80 for cells that was not measured sufficiently long for them to degrade by 20 %. with respect to the initial performance.



- This value will by definition have a significant uncertainty to it, as it is not measured but extrapolated under the assumption linearity but without a detailed and stabilised extrapolation protocol. This estimate is, however, not without value as it enables a ruff comparison between all cells for with the stability has been measured.
- If there is an experimental T80, leave this field empty.

Outdoor. PCE. Tse80 [h]

Format: Float
Default: nan
Description: An estimated T80s for cells that was not measured sufficiently long for them to degrade by 20 %. with respect to the performance after any initial burn in phase.

- This value will by definition have a significant uncertainty to it, as it is not measured but extrapolated under the assumption linearity but without a detailed and stabilised extrapolation protocol. This estimate is, however, not without value as it enables a ruff comparison between all cells for with the stability has been measured.
- If there is an experimental T80s, leave this field empty.

Outdoor. PCE. After 1000 h [% of initial PCE]

Format: Float
Default: nan
Description: The efficiency, PCE, of the cell after 1000 hours

- Give the efficiency in %
- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Outdoor. Power generated [kWh/year/m^2]

Format: Float
Default: nan
Description: The yearly power generated during the measurement period

- If there are uncertainties, only state the best estimate, e.g. write 20.5 and not 19-20
- If unknown or not applicable, leave this field empty.

Outdoor. Link. Raw data for outdoor trace

Format: Text string
Default: Empty text string
Description: A link to where the data file for the measurement is stored

- This is a beta feature. The plan is to create a file repository where the raw files for stability data can be stored and disseminated. With the link and associated protocols, it should be possible to programmatically access and analyse the raw data.

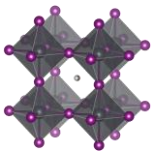
Outdoor. Detaild weather data available [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE if detailed weather data is available for the measurement period

Outdoor. Link. Detailed weather data

Format: Text string
Default: Empty text string
Description: A link to where the data file for the measurement is stored

- This is a beta feature. The plan is to create a file repository where the raw files for stability data can be stored and disseminated. With the link and associated protocols, it should be possible to programmatically access and analyse the raw data.



Outdoor. Spectral data available [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE measured spectral data are available for the measurement period

Outdoor. Link. Spectral data

Format: Text string
Default: Empty text string
Description: A link to where the data file for the measurement is stored

- This is a beta feature. The plan is to create a file repository where the raw files for stability data can be stored and disseminated. With the link and associated protocols, it should be possible to programmatically access and analyse the raw data.

Outdoor. Irradiance measured [TRUE/FALSE]

Format: Boolean. i.e. TRUE or FALSE
Default: FALSE
Description: TRUE measured irradiance data are available for the measurement period

Outdoor. Link. Irradiance data

Format: Text string
Default: Empty text string
Description: A link to where the data file for the measurement is stored

- This is a beta feature. The plan is to create a file repository where the raw files for stability data can be stored and disseminated. With the link and associated protocols, it should be possible to programmatically access and analyse the raw data.