Laboratory for Thin Films and Photovoltaics
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Switzerland

Empa Materials Science and Technology

ETH Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Master Thesis

Scalable deposition of Pb-Sn alloyed narrow bandgap perovskites using blade-coating for solar cell application

Research area

Photovoltaics (PV)

Thin-film coating

Perovskite solar cells

Blade-coating

Chemical engineering

Novel material synthesis

Focus

☒ Experimental
☒ Opto-electronic characterization
☒ Analytical
☒ Literature and research

Duration

4-6 months

Entry

As soon as possible

Contact

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Literature

[1] *Nat. Energy* **2022**, *7*, 923-931. DOI:1038/s41560-022-01102-w

[2] *Energy Environ. Sci.,* **2022**,*15*, 2096-2107

Motivation

Pb-Sn alloyed narrow bandgap (~1.25 eV) perovskite absorbers are promising candidates for single junction and all perovskite tandem solar cell applications.[1] However, most of the high eficiency Pb-Sn perovskite solar cells (PSCs) are reported using lab scale spin-coating method, which is not a scalable process.[2] Therefore, it is urgent to develop a scalable deposition process for the PSCs device fabrication for commercializnig this technology. Currently, scalable blade-coated narrow-bandgap PSCs already being developed within the Laboratory for Thin films and Photovoltaics at Empa and a good efficiency (17%) baseline processes are available for these devices. Further improvement in the device performance is limited by the thickness of the absorber (~ 400 nm), which consequently lead to lower short circuit current density (J_{SC}). In this project, we are aiming to increase the absorber thickness without compromising the optoelectronic quality of the perovskite absorber to achieve a J_{SC} above 30 mA cm^{-2}. In line with this objective, we are planning to implement a co-solvent assisted perovskite ink dilution strategy with which we would be able to deposit thicker perovskite layer.

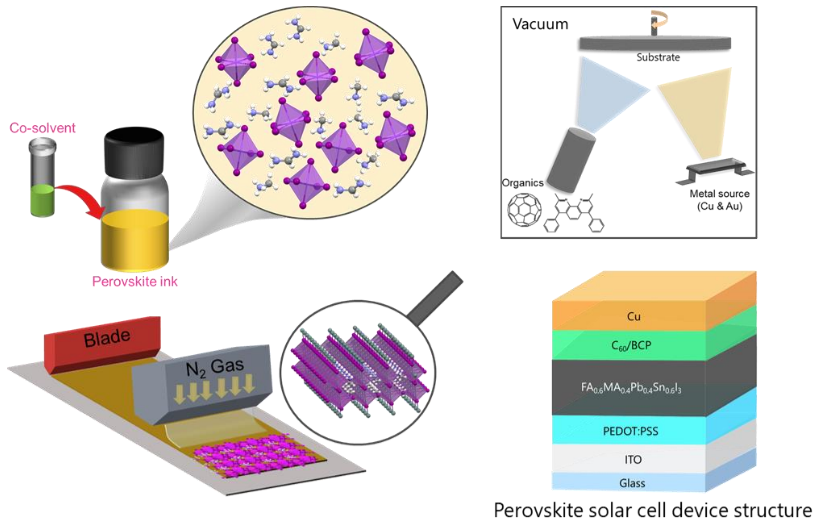

Figure 1. *Schematic of the work flow including perovskite ink engineering, blade-coating, physical vapor deposition, and the final solar cell device architecture.*

Your task

You will be trained to fabricate the narrow-bandgap perovskite (~1.25 eV) solar cells using blade coating method on glass substrates. The candidate will acquire sound knowledge in perovskite compositional tuning and co-solvent assisted ink engineering to achieve a J_{SC} above 30 mA cm^{-2} using our existing blade coating setup. You will learn to use SEM, XRD, PL&TRPL, NMR, FT-IR, etc., to study the structural and optoelectronic properties of the perovskites and evaluate the photovoltaic performance and stability of the solar cells using JV, EQE, stress test chamber, etc. In addition, you will also learn to synthesize novel small organic molecules to passivate the interfacial defect states and employ them in the blade-coated PSCs.

Key tasks include:

- Development of high-quality perovskite absorber using blade coating method.
- Perovskite ink development using co-solvent based formulation.
- Characterization of the perovskite thin films and solar cells.

Requirements

- Strong interest in solar cells
- Background in materials science, semiconductors, physics, chemistry etc.
- Master students in Switzerland is preferred

Notes

Please include a CV and a transcript of records with your application. The field of photovoltaic research requires a multidisciplinary knowledge. Hence, students with backgrounds in materials science, physics, chemistry etc. are welcome to apply. The project can be tailored to student's expertise and interests. For further information, please contact Johnpaul.