**Laser-based patterning for monolithic interconnection of thin-film tandem solar modules**

Thin-film tandem solar cells using perovskite and Copper Indium Gallium Selenide (CIGS) photovoltaic absorbers have shown excellent efficiencies on small area cells (< 1 $cm^2$), and show potential to surpass single-junction efficiency limits. The transition from cell to module level of these exciting technologies requires monolithic interconnection, were small cell strips are connected in series through patterning approach (**Figure 1**). At Empa, we have utilized laser-based patterning to realize CIGS and perovskite single-junction mini-modules. We want to develop similar patterning approach for high-efficiency thin-film tandem architecture with perovskite-CIS material system.

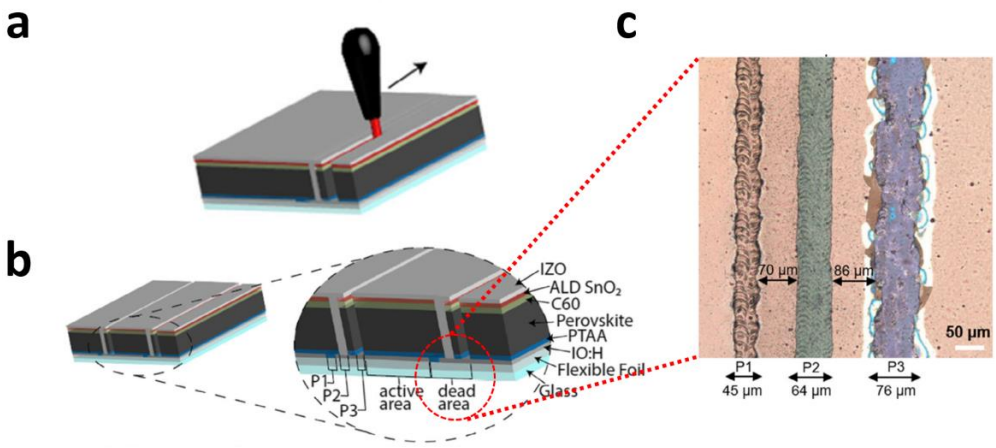


**Figure 1.** Schematic illustration of **a**. laser-patterning for monolithic interconnection, and **b**. a perovskite module with indication of active and dead area (Laser scribed P1, P2 and P3 region) and **c**. Optical micrograph of laser scribed interconnection region in a perovskite module.

This project aims to investigate possible interconnection schemes and optimize laser-patterning process to realize monolithic interconnection for perovskite-CIS 2T tandem module.

During the course of project, the student will:

- Explore advanced thin-film photovoltaic perovskite, CIS and tandem solar cell technologies.
- Understand laser ablation mechanism on perovskite and CIS material systems.
- Optimize laser patterns for perovskite and CIS solar modules with optoelectronic characterizations.
- Building on the acquired expertise to develop a process for monolithic 2 terminal perovskite-CIS tandem modules. We are looking for students in the field of Physics/Process/Material/Electrical engineering willing to work in a motivated, multi-disciplinary team performing cutting edge science in the field of thin film photovoltaics. The candidate is dedicated to analytical instrumental based work with a strong focus to applied research.

**Duration:** 4-7 months (Master thesis/Semester project)

**Starting date:** anytime

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