Defect engineering in kesterite absorber for monograin layer solar cells

Summary

This PhD project will contribute to the development of an innovative, customized and efficient building integrated photovoltaic technology based on kesterites Cu2ZnSn(S,Se)4 being the most promising sustainable emerging thin film solar cell materials. The project focuses on the defect engineering in kesterite absorber.

Research field:	Chemical, materials and energy technology
Supervisors:	Prof. Dr. Maarja Grossberg-Kuusk Dr. Marit Kauk-Kuusik
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between May 03, 2021 00:00 and May 31, 2021 23:59 (Europe/Zurich)

Description

The research group hosting the PhD project is developing an innovative, customized and efficient building integrated photovoltaic (BIPV) technology based on kesterites Cu2ZnSn(S,Se)4 (CZTSSe) that among the environmentally friendly and abundant emerging thin film (TF) solar cell (SC) materials have shown the highest potential. In addition to the sustainability, CZTSSe have many advantages, namely its suitable band gap (in between 1 to 1.5 eV depending on the S/Se ratio) for solar energy conversion and high absorption coefficient (~ 104 cm-1). The latter fact makes the emerging TF SC technologies especially appealing for BIPV applications where the lightweight and mechanical flexibility of the PV elements is needed.

The aim of the PhD project is to bring the CZTSSe PCE to the next level by focusing on the currently shown key issue that is strong recombination of photogenerated charge carriers via various routes leading to short minority carrier lifetime and diffusion length and resulting in large open circuit voltage deficit of CZTSSe SCs. The most crucial sources of strong recombination are identified as: a) abundance of harmful point defects and defect clusters, b) severe band tailing, and c) non-optimized interfaces in the CZTSSe SCs. The PhD project focuses on the defect engineering in kesterite absorber via novel doping and alloying strategies. The result of the PhD work would be improved performance of the CZTSSe solar cells for BIPV. The PhD work will contribute to the projects: Estonian Research Council grant PRG1023 and EU project CUSTOM-ART.

Responsibilities and tasks:

- defect studies by using various electrical and optical characterization methods such as luminescence, quantum efficiency, temperature dependent current-voltage analysis etc.
- Writing research publications and presenting the results of PhD project at scientific conferences.

Qualifications:

- Master's degree in materials science, preferably in the field of semiconductor materials research
- Excellent knowledge in semiconductor physics and/or chemistry
- Experience with structural, optical and electrical materials characterization techniques

- Excellent English in communication and in writing, team working attitude

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