Interface engineering of kesterite based monograin layer solar cells

Summary

The PhD project focuses on the modification of the p-n junction of kesterite solar cells to take the device efficiencies to the next level targeting above 15%. The main objective is to produce sustainable, cost-effective, light-weight, flexible and semitransparent photovoltaic devices in frame of Estonian PRG1023 and EU CUSTOM-ART projects. Main supervisor: Kristi Timmo. Co-supervisor: Marit Kauk-Kuusik.

Research field:	Chemical and Materials Technology
Supervisors:	Marit Kauk-Kuusik Kristi Timmo
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

Currently, the efficiencies of Cu2ZnSn(S,Se)4 (CZTSSe) monograin layer solar cells are mainly limited by high recombination losses in the bulk and at the p-n junction interface that need to be overcome. One approach to noticeably improve the performance of CZTSSe monograin layer solar cells is to apply before the buffer layer deposition special post-growth treatment to the monograin powder crystals` surfaces. This process includes the optimization of chemical etching and thermal treatment regimes to modify the interface at the absorber of CZTSSe monograin layer solar cells as well as an extensive analysis of quality and optoelectronic properties of the interfaces. Another major subject of the project is optimizing the band-alignment of the kesterite based monograin layer solar cell structure that would additionally lead to reduced recombination at the interfaces. For example, CZTS bandgap is around 1.5 eV, the band alignment between CZTS and CdS is not ideal (“cliff-like”), promoting interface recombination. An addition of intermediate layer between absorber and buffer layers will be studied in this work. In the whole picture, significantly reduced amount of recombination at the absorber/buffer interface will lead to improved charge carrier lifetime and collection enabling higher power conversion efficiencies.

The results of the project should fill the gaps in knowledge about perspective kesterite based monograin layer solar cells and enable to reach economically relevant energy conversion efficiencies of around 15%. The PhD work will contribute to the projects: Estonian Research Council grant PRG1023 and EU project CUSTOM-ART.

Applicants should fulfil the following requirements:

- Master's degree in materials engineering, chemistry, physics or equivalent
- previous experience in research activities, preferentially in the field of semiconductor materials
- knowledge of the processing of solar cells, as well as advanced characterization techniques will be positively assessed
- high level of English and very good communication and writing skills
- problem-solving attitude and a strong desire to stay up-to-date with recent advancements in the field
- ability to work independently

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