Development of front and back contacts for flexible and semitransparent multinary chalcogenide based solar cells

Summary

Photovoltaic (PV) is one of the fastest growing renewable energy technologies. Its potential is enormous and constant increase in the installation of photovoltaic modules is expected being supported by continuous improvement in performance and reduction in cost. The research group hosting the proposed PhD project is developing an innovative, customized and efficient building integrated photovoltaic (BIPV) technology based on multinary chalcogenide materials. The PhD project focuses on the development of alternative front contacts and entirely new transparent back contacts for monograin layer solar cells aiming to produce cost-effective, light-weight, flexible and semitransparent photovoltaic devices.

Research field:	Chemical, materials and energy technology
Supervisors:	Dr. Marit Kauk-Kuusik Mati Danilson
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between June 01, 2020 00:00 and July 03, 2020 23:59 (Europe/Zurich)

Description

The aim of this PhD project is to develop and study front and back contacts for flexible and semitransparent multinary chalcogenide based monograin layer solar cells (MGL SC). Unlike in the case of conventional thin film solar cells in substrate configuration where Mo(S,Se)2 is used as a back contact (BC), in the MGL SC concept the graphite is used instead. However, aiming at semi-transparent BIPV applications alternative semi-transparent BC has to be developed. The requirement on alternative contacts is stability, transparency and electrical contact to the absorber layer. The front contact in the MGL SC structure combines the buffer layer and transparent conductive oxide (TCO) covered by highly conductive metal nanowires. The mechanical stability of metal nanowires compared to brittle TCO would enable improved flexibility of the front contact crucial for flexible BIPV. Currently is used non-sustainable CdS buffer layer, which should be replaced with more sustainable compound resulting also more favorable band alignment between absorber/front contact interface. In addition, the developed buffer layer has to be compatible with the following TCO layer. The result of the PhD work would be an optimized non-toxic front contact and a stable semi-transparent ohmic back contact for cost-effective, light-weight, flexible and semitransparent BIPV applications.

Responsibilities and tasks
The main tasks of PhD work are:

- development of alternative buffer/TCO layers by chemical/physical deposition methods for front contacts
- development of new flexible, transparent and highly conductive back contact and implementation of developed contact layers into monograin layer solar cells
- writing research publications and presenting the results of PhD project at scientific conferences

Qualifications
Master of Science in engineering physics, materials science, materials chemistry or equivalent.

The applicants should fulfill the following requirements:

- The successful candidate should hold previous experience in research activities, preferentially in the field of chalcogenide based devices.
- Knowledge of the processing of solar cells with these materials, as well as advanced characterization techniques will be positively assessed.
- Strong collaboration spirit and good communication skills in oral and written English are required.

- Candidate should show a problem-solving attitude and a strong desire to stay up-to-date with recent advancements in the field and be able to work independently.

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