Fabrication and characterization of Sb2Se3-based bifacial solar cells

Summary

Sb2Se3-based solar cells are exhibiting promising perspectives, with a record efficiency above 10%. This PhD project is about finding the way in controlling electrical conductivity type and magnitude and the buffer layer for controlling electrical charge transport to/from Sb2Se3 by theoretical and experimental methods.

Research field:	Chemical and Materials Technology
Supervisors:	Nicolae Spalatu Smagul Karazhanov
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

Sb2Se3-based solar cells are one of the emerging cells in the last five years that demonstrate promises for high efficiency at low fabrication cost. However, the demonstrated Sb2Se3-based cell efficiency is still below 10%, which is far below the theoretically predicted efficiency of 30%. The reason for that is, in part, related to lack of understanding in the material's properties and synthesis. For example, it is not clear which defects, impurities or defect-impurity complexes can provide n- or p-type electrical conductivity, methods of doping. Another important unresolved challenge is electrical charge carrier transport to/from Sb2Se3, finding a material that can be a buffer layer or passivation layer.

The aim of the PhD project is to study electrical charge carrier transport to/from Sb2Se3, material’s research that can be a buffer layer or surface passivation layer, fabrication and characterization of Sb2Se3 solar cells. To solve the multidisciplinary task, complex theoretical and experimental methods of research will be employed. Physical and chemical methods of synthesis, characterization by advanced tools such as HR TEM, XPS, synchrotron facilities will be used. Other experimental methods of materials synthesis and characterization such as, e.g., SEM, EDX, FTIR, XRD, XPS, and optical instruments will be performed in TalTech. PL image, optical instruments, SEM, 4 point probe methods as well as device modelling will be performed in IFE. TCAD SILVACO will be used for device modelling for the study of charge carrier transport and of solar cell performance.

The results will be documented in at least three journal articles in high impact journals such as Solar Energy, Solar Energy Mater. Solar Cells and J. Appl. Phys. The results will be presented at international conferences such as EU PVSEC and E-MRS. The infrastructure and trained manpower is available in TalTech and IFE to implement the planned work.

Applicants should fulfil the following requirements:

- Bachelor's and Master's degree in Physics, Chemistry, Electronic Engineering, Materials Engineering, or a related field
- Demonstrable previous research experience in thin film chalcogenide solar cell technologies
- Knowledge of the use of different physical and chemical deposition techniques (CSS, VTE, sputtering, CBD, CSP), processing equipment (PDTs, furnaces) and characterization tools (XRD, SEM, Van-der-Pauw, solar simulator, spectral response)
- Excellent communication skills in English (both written and verbal) and collaboration skills

- Competencies in using data analysis & graphing software: MS Office (Word, Excel, and PowerPoint), Origin

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