

Development of Low Temperature Antimony Chalcogenide Disruptive Technologies for Next Generation Photovoltaics

Summary

Current research efforts in Photovoltaics (PV) are focused on identification and development of new emerging semiconductor materials with very limited or absent concerns on material availability, toxicity and cost-efficient processability. A big emphasis is on development of antimony chalcogenide compounds – identified as a new class of materials with tremendous potential for next generation PV applications. These materials represent a strong research direction in the Laboratory of Thin Film Chemical Technologies, Department of Materials and Environmental Technology at TalTech. In this context the laboratory opens positions for highly enthusiastic and motivated students to perform research under the doctoral study programme Chemical and Materials Technology, for the period of 2020-2024. The candidate will carry out a multidisciplinary scientific activity in the framework of the projects PRG627, TAR16016EK, H2020 ERA Chair of Emerging Next Generation Photovoltaics on the development and characterization of thin films and photovoltaic devices based on Sb₂Se₃, Sb₂S₃ and related alloys PV absorber materials.

Research field:	Chemical, materials and energy technology
Supervisors:	Dr. Nicolae Spalatu Dr. Atanas Katerski
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 objective of the current PhD thesis is to develop and optimize the green and earth-abundant Sb-chalcogenide absorber materials, from fundamental studies of fabrication processes, materials and interfaces, to the fabrication of complete devices, their characterization and their optimisation.

The PhD student will be involved in all the solar cells processing stages. This will include the fabrication of absorber layers on different substrates: glass, glass/TCOs, glass/Mo, glass/TCOs/window layer, using cost-effective, low temperature processes, close-spaced sublimation (CSS) and vacuum thermal evaporation (VTE) techniques. Various CSS deposition parameters (substrate and source temperature, growth pressure) and post-deposition treatments (in tube-furnaces, hot-plates) will be optimized for obtaining single-phase, high-crystallinity, dense, and homogeneous absorber layers with suitable optoelectronic properties and proper thicknesses for thin film solar cell applications.

The PhD student will also fabricate different window layers such as CdS, by CSS and chemical bath deposition methods (CBD), and TiO₂ by chemical spray pyrolysis (CSP) and will identify the optimal window/buffer partner in solar cells. The student will prepare the photovoltaic solar cells based on these materials, define the ad hoc selective contacts for efficient charge extraction and characterize the materials properties and solar cells output parameters.

The proposed research project will help the student to acquire a vast range of competences and skills in developing and design thin film solar cells, will strengthen the researcher's ability to publish in international journals, as well as broadening the network of international contacts with companies and other research groups in the PV field from EU and the world at large through the participation at different international conferences.

Qualifications:

- The successful applicant will hold a Bachelor and Master degree in Physics, Chemistry, Electronic Engineering, Materials Engineering or a related field, and demonstrable previous research experience in thin film solar cell technologies, with a strong focus on the fabrication/characterization of films and solar devices, and knowledge on 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).



- Previous experience on the development of chalcogenide solar cells (including CdTe, SnS, CIGS based devices) on different kinds of substrates suitable for device integration in different kinds of elements and systems will be well evaluated.
- Excellent communication skills in English (both written and oral) are an essential requirement.
- Competences in using data analysis and graphing software: Microsoft Office (Word, Excel and PowerPoint), Origin.



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