Development of antimony chalcogenide thin films for semi-transparent solar cells

Summary

Photovoltaic (PV) Solar Energy Conversion is a key renewable energy source to replace burning fossil fuels– a cause of substantial CO2 emissions and environmental pollution. Stricter regulations and rising raw materials demand has prompted intensive studies on non-toxic, earth abundant, stable materials. Among them, antimony chalcogenides (Sb(S,Se)) are recognized as part of the pinnacle of emerging PV materials. This PhD thesis topic is focused on the development of Sb2S3 thin films with controlled orientation of crystallites, optimization of low-temperature deposition processes and fabrication of semi-transparent solar cells for next-generation BIPV applications, e.g. electricity producing solar windows–the key to turn buildings from energy users to energy producers. The laboratory opens position for highly enthusiastic and motivated student to perform research 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.

Research field:	Chemical, materials and energy technology
Supervisors:	Prof. Dr. Ilona Oja Acik Prof. Dr. Malle Krunks
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 goal of the PhD thesis topic is to develop earth abundant stable inorganic materials for semitransparent thin film solar cells for next-generation BIPV applications, e.g. electricity producing solar windows and as a top cell in Si and/or CIGS tandem solar cells. The PhD student will be involved in all the solar cells processing stages. In this PhD thesis, antimony chalcogenide and metal oxide thin films will be fabricated by robust, rapid, resource saving, high yield and easily scalable method such as ultrasonic spray pyrolysis. Spray deposition has great potential to become front- line technology for rapid, cost-effective, resource saving, large-area and high yield mass production of solar cell. Sb2S3 is emerging PV material: tunable bandgap (1.1-1.7 eV), high absorption coefficient (>104 cm-1), earth-abundant non-toxic constituents. Our research group, was the first one to demonstrate semi-transparent Sb2S3 solar cell by chemical deposition methods. In the current stage of the development, Sb2S3 thin film solar cells fabricated by ultrasonic spray pyrolysis shows efficiency of 5.5 % under 1sun. The AVT of structure glass/TCO/TiO2 /Sb2S3 is 30% fulfilling the semitransparency requirement of solar windows. The key for further increasing the efficiency of the solar cells relays on utilization of the unique optoelectronic properties of one-dimensional Sb2S3 thin films and optimization of solar cells.

Responsibilities and tasks:

- Development of deposition strategies for Sb2S3 thin films with controlled orientation by the chemical spray pyrolysis method.
- Development and optimization of semi-transparent solar cells and its constituent layers, including Sb2S3 thin films, by chemical deposition methods.
- Writing of minimum three ISI WoS papers and presentation of results at local and international conferences.

Qualifications

The successful applicant will hold a Master degree in Chemistry, Materials Science or a related field.

The applicants should fulfill the following requirements:

- Previous research experience in thin film technologies.

- Knowledge and experience on the thin films fabrication by chemical deposition techniques (spray pyrolysis or atomic layer deposition) and characterization techniques (XRD, SEM, UV-VIS, Raman).
- Knowledge and experience in thin film solar cell fabrication and characterization.
- Excellent team working attitude and 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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