

# Development of semi-transparent thin films solar cells with a focus on exploring novel hole transport materials

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## Summary

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*The broad goal of the project is to fabricate semi-transparent solar cells containing Sb-based chalcogenide absorber materials by employing simple and economic chemical deposition routes. The project targets to address the questions through: a) Process parameter optimization to fabricate suitable electron transport layer and absorber layers by industrially benign ultrasonic spray pyrolysis deposition process, b) Exploring novel, cost-effective and transparent hole transport materials, synthesized by a collaborative group in Lithuania, to demonstrate in Sb-based semi-transparent solar cells, c) Systematic investigation of solar cell layer for their comprehensive understanding and to identify the drawback and improve the process parameters to develop efficient semi-transparent solar cells.*

Research field:	Chemical, materials and energy technology
Supervisors:	Prof. Dr. Ilona Oja Acik Dr. Sreekanth Mandati
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between October 01, 2022 00:00 and October 23, 2022 23:59 (Europe/Zurich)

## Description

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The candidate will carry out a multidisciplinary scientific activity in the framework of the projects EEA grants S-BMT-21-1(LT08-2-LMT-K-01-003), PRG627, TAR16016EK, and H2020 ERA Chair of Emerging Next Generation Photovoltaics. The PhD thesis is aimed at development of earth abundant stable materials for semi-transparent thin film photovoltaics (PV). Antimony chalcogenides are pursued as absorbers while metal oxide films would serve as electron transport layers and both these layers will be fabricated by chemical deposition methods. Majorly, robust, resource-saving and easily scalable methods such as ultrasonic spray pyrolysis, which has great potential to become front-line technology for rapid, cost-effective, large-area and high yield mass production of materials, will be utilized for the fabrication of solar cells.  $\text{Sb}_2\text{S}_3$  is an emerging PV absorber with a bandgap of 1.8 eV and relatively large absorption coefficient ( $\approx 10^5 \text{ cm}^{-1}$ ) with earth abundant and non-toxic constituents. Our group has already demonstrated semi-transparent  $\text{Sb}_2\text{S}_3$  solar cells with efficiencies  $> 5\%$  under 1 sun and an average visible transmittance of  $\approx 30\%$  (devoid of metal contact). In this thesis, the candidate will focus on exploring novel cost-effective hole transport materials (HTM), developed in collaboration with Kaunas University of Technology, Lithuania, to successfully apply in semi-transparent  $\text{Sb}_2\text{S}_3$  solar cells. The prospective scholar is expected to identify suitable method and optimize formulations to demonstrate the effectiveness of novel HTM layers in  $\text{Sb}_2\text{S}_3$  solar cells. Further, advanced characterization of solar cell and individual layers will be performed to unravel the band energetics, defect densities and carrier lifetime.

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.

## Supervisors

Main supervisor: Dr. Sreekanth Mandati  
Co-supervisor: Prof. Dr. Ilona Oja Acik

## Responsibilities and (foreseen) tasks:

- Fabrication of  $\text{Sb}_2\text{S}_3$  solar cells through optimizing underlying metal oxide and absorber layers.
- Optimization of method and formulations for successful demonstration of new hole transport materials in semi-transparent  $\text{Sb}_2\text{S}_3$  solar cells.
- Characterization of materials and solar cell devices using various dedicated characterization techniques.
- Analysis of the research data, preparing reports, presentation at conferences (poster, oral talk), write research papers.
- Contribute to the organization and dissemination of research and practitioner workshops where project findings are presented.

### **Applicants should fulfil the following requirements:**

- Bachelor and Master degree in Physics, Chemistry, Electronic Engineering, Materials Engineering or a related field
- Previous research experience in thin film solar cell technologies, with a background in chemical deposition techniques will be advantageous
- Excellent communication skills in English (both written and oral) are an essential requirement
- Capacity to work both as an independent researcher and as part of an international team
- Capacity and willingness to provide assistance in organizational tasks relevant to the project
- Competences in using data analysis and graphing software: Microsoft Office (Word, Excel and PowerPoint), Origin

### **We offer:**

- 4-year PhD position in the research group focused on emerging PV technologies in Estonia
- The chance to do high-level research in one the most booming emerging photovoltaic field
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers in the fields of material science

### **Additional information**

For further information, please contact Dr. Sreekanth Mandati ([sreekanth.mandati@taltech.ee](mailto:sreekanth.mandati@taltech.ee)) and Prof. Ilona Oja Acik ([ilona.oja@taltech.ee](mailto:ilona.oja@taltech.ee)) or visit <https://taltech.ee/en/laboratory-thin-film-chemical-technologies>



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