Solution-processed CZTS and its n-layers

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“Solution-processed CZTS and its n-layers”

Abstract:

One key compound in the search for the next-generation photovoltaic (PV) absorber material is the kesterite ($Cu_2ZnSn(S_xSe_{1-x})_4$ or CZTSSe): As a p-type semiconductor with a tunable band gap and high absorption coefficient, it is considered the potential successor of $Cu(In,Ga)Se_2$ (CIGS) in the field of thin-film PV. In particular, the pure-sulfide Cu_2ZnSnS_4 (CZTS) contains neither toxic (Cd or Se) nor rare (In and Ga) elements. Additionally, it adapts a similar device architecture and thus comparable manufacturing facilities as the commercially available CIGS. Of the fabrication methods available to synthesize CZTSSe, solution-processing is interesting from an economical perspective. Non-vacuum methods offer a lower environmental impact due to lower electricity consumption in the manufacturing stage, and lower capital expenditure (CAPEX) for establishing production lines. The „DMSO aprotic molecular ink” route has recently proven a competitive approach for synthesis of CZTSSe with power conversion efficiencies exceeding 10%. Meanwhile, limited effort has been devoted to synthesis of the pure-sulfide CZTS from the solvent DMSO, even though the sulfide kesterite and its alloys have more favorable band gaps for advanced tandem concepts. In our work, CZTS solar cells with an efficiency of 4.65% were synthesized under ambient conditions.

This talk is divided into two parts. First, I will share our results on solution-processed CZTS and map out the process from ink to film to understand the mechanism of formation. Several things happen from once you mix your salts until the final film has formed. We review processes such as complex formation, the thermal behavior of the ink, and how the film dries and crystallizes. Secondly, I will introduce our current work on new n-type layers, and present the research objectives for our current projects.

Brief CV:

Sara Engberg, Researcher (tenure track)

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Sara Engberg, PhD, is a Researcher in the Photovoltaic Materials and Systems group at DTU Fotonik. She has many years of experience in solution-processed CZTS solar cells, and has recently moved into the field of novel n-type layers for emerging solar cells. She has received a grant from the Independent Research Fund Denmark to investigate sputtered oxides as n-type materials, and her research interests lie in interface characterization and semiconductor device physics. She has authored and co-authored more than 16 papers. She obtained her B.Sc. in Physics and Nanotechnology at the Technical University of Denmark (DTU) and her M.Sc. in Nanotechnology at the University of Pennsylvania (UPenn) in the U.S.