I. Physikalisches Institut (IA)
Phasenwechselmaterialien
Prof. Dr. rer. nat. Matthias Wuttig

BachelorThesis

Growth optimization of novel materials for photovoltaic applications

Subject area:

Today, one of the best photovoltaic absorber materials are CdTe and Cu(In, Ga)Se2 (CIGS), which achieved conversion efficiencies of approx. 22%. However, since Cd is toxic and In is expensive, new absorber candidates are wanted.

A promising candidate is CuSbSe2: It has low toxicity and low cost. Additionally, it has a high theoretical conversion efficiency of 30% [1] and a suitable band gap (approx. 1.1 eV) for photovoltaic application [2].

To determine its properties like the band gap, CuSbSe2 thin films with low surface roughness and good texture (distribution of the crystallographic orientation in the sample) are needed.

In this work, you will optimize the thin film growth of CuSbSe2 produced by Co-Sputter deposition of Cu2Se and Sb2Se3 in a photovoltaic sputter chamber. Through changing deposition parameters like temperature and chamber pressure, the thin film growth can be influenced (and thus optimized).

Additionally, you will characterize the thin film properties with several methods like energy dispersive X-ray spectroscopy (EDX) for the thin film composition, X-Ray Diffraction (XRD) for the crystallinity and atomic force microscope (AFM) for the surface roughness. With this information's the film quality can be improved in an iterative process.

In the end, optical methods like Ellipsometry can investigate the materials' band gap.

Since one of your supervisors does not speak German, we prefer English as a written language in your thesis.

Tasks:

- Produce CuSbSe2 thin film with Sputter Deposition and optimize its growth
- Characterize thin film properties with XRD, AFM and EDX

Your Profile:

- Good background knowledge in solid state physics
- Knowledge in Python and/or MATLAB are desirable, to analyses your data
- Good Teamwork and English skills

References

[1] C. Wang, B. Yang, R. Ding, W. Chen, R. Kondrotas, Y. Zhao, S. Lu, Z. Li und J. Tang, „Reactive close-spaced sublimation processed CuSbSe2 thin films and their photovoltaic application," *APL Materials,* Bd. 6, 2018.

[2] H. Yan, . R. Xiao, Y. Pei, K. Yang und B. Li, „Structural, electrical and optical characteristics of CuSbSe2 films prepared by pulsed laser deposition and magnetron sputtering processes," *Journal of Materials Science: Materials in Electronics,* Bd. 31, p. 644–651, 2020.

Azam Karami
✉ karami@physik.rwth-aachen.de
28A 506 0241 / 80 27207

Maria Häser
✉ haeser@physik.rwth-aachen.de
28B 505 0241 / 80 27167