Laboratory for Thin Films and Photovoltaics
Überlandstraße 129
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Switzerland

Empa
Materials Science and Technology

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Research Internship / Semester Project

Structural investigations of ASSB battery materials using XRD and validation of the annealing process

Research area

Thin-film techniques

All-solid-state batteries

Amorphous / Crystalline structures

Focus

☒ Experimental
☐ Electrochemical characterization
☐ Analytical
☒ Development of measurement techniques
☐ Modeling
☐ Simulation
☐ Literature and research

Course of Study

☒ Mechanical and Process Engineering
☒ Materials Science
☒ Physics
☒ Chemistry and Applied Biosciences
☒ Information Technology and Electrical Engineering
☐ Computer Science

Entry

As soon as possible

Contact

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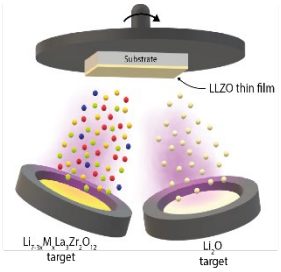
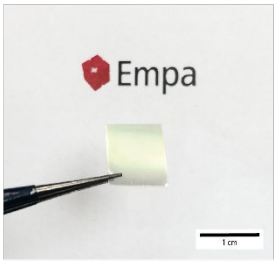
Literature

Sastre, J. *et al. Adv Mater Interfaces* **7**, 2000425 (2020).

Aribia, A. *et al. J Electrochem Soc* **168**, 040513 (2021).

Motivation

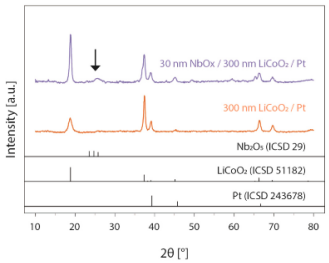




In order to realize the true potential of lithium-ion batteries (LIBs) in the coming decades, continued innovation toward safer, more powerful, and better battery design is essential. One of the most promising approaches to improving the safety of LIBs is to replace the "liquid" ion-conducting electrolyte in a conventional LIB with a "solid" Li conducting electrolyte ceramic in a solid-state battery (SSB) configuration. To date, however, there are obstacles - e.g., maintaining the crystalline phase and the desired fast transport properties - that prevent the integration of solid-state Li electrolytes in commercial batteries.
Nevertheless, there are approaches such as the thin-film LIB architecture, which is a form of SSBs that combines the advantages of SSBs with the advantages of thin-film manufacturing processes. For example, the film thickness can be reduced by up to three orders of magnitude for both crystalline and amorphous phases of solid state electrolytes, compared to classical manufacturing processes such as pellet fabrication.

Task

As part of your project, a program in LabVIEW is to be developed for the control and automation of an existing laboratory furnace - connected to a glovebox. For this purpose, the various mass flow controllers, pumps and sensors are first to be integrated into the system and then automation processes are to be developed in coordination with the team. The laboratory furnace will then be putted into operation and the annealing process validated. For this purpose, various thin-film samples such as LCO etc. are to be annealed and subsequently examined by means of Grazing-Incidence X-ray diffractometry (GI-XRD) and compared with previously recorded X-ray diffractograms.



Key tasks include:

- Familiarization and learning of LabVIEW and the XRD technique.
- Programming of a LabVIEW software to control and automate a laboratory furnace.
- Putting in operation and validation of the furnace
- Evaluation / comparison of XRD diffractograms

Requirements

- Experience in the use of LabVIEW
- Ideally basic knowledge in the field of battery research
- Interest in batteries and in the further development of a laboratory test bench
- Laboratory experience is desirable

Notes

Please include a curriculum vitae and a transcript of records with your application. The field of battery research requires a multidisciplinary knowledge. Hence, students with backgrounds in materials science, electrical engineering, etc. are welcome to apply. The project can be tailored to the field of studies and interests. You should be able to work independently and be motivated to learn new topics. Initial programming experience is desirable. For further information, please contact André Müller.