Thesis Project Offer

Joint Research and Education Programme “Palestinian-German Science Bridge PGSB”
Forschungszentrum Jülich GmbH & Palestine Academy for Science and Technology

Thesis type*

☐ BSc ☒ MSc ☐ PhD

Intended starting date (approx.): flexible

Contact details of supervisor/responsible host at Forschungszentrum Jülich

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RWTH Aachen University (Prof. Olivier Guillon)

Co-Supervisor at Palestinian university (if applicable)

Title Degree First name Surname

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University/institution Department/faculty/institute

Project description*

Master Thesis: Durable Cathodes for All-Solid-State Lithium Ion Batteries

Lithium ion batteries with typical liquid electrolytes are suffering from safety issues caused by the flammable liquid. All-solid-state batteries with a thin incombustible inorganic solid electrolyte represent an alternative technology providing higher safety. Composite cathodes made e.g. from Li1/2La1/2Zr2012 (LLZ) and LiCo02 (LCO) are used to store the electric energy. However, LCO undergoes a volume change of approximately 4% when being delithiated. The typical microstructure used at the institute has been reconstructed in 3D with FIB/SEM and an elastic finite element simulation yielded compressive stresses in the LCO phase up-to 1.0 GPa and tensile stresses in the LLZ phase up-to 1.3 GPa, respectively. These resulting stresses would cause plastic deformation and fatigue and shall be minimised by a finite-element study. The influence of microstructural parameters like the volume ratio of the two phases, the grain size, and the porosity on the resulting stresses shall be investigated. As these microstructures cannot be acquired experimentally without too large effort, they shall be generated by a material modelling software (GeoDict). The results shall be validated with the experimentally acquired microstructure and compared with simple cases that can be solved analytically. The found relationships shall be used to propose stress-optimised microstructures that should evaluated from the point of achieved charge capacity and experimental processing feasibility.

The student for this proposed master thesis should have studied material science, physics,
mechanical engineering or a similar subject and should enjoy solving applied problems numerically and analytically.

Date*  Signature*
31.1.2017 [signature]

* required field