ACCELERATED BENCHMARKING OF LI-GARNET ELECTROLYTE MATERIALS

All-solid-state Li-ion batteries are an emerging alternative for next-generation energy storage devices, that bring promise of low cost, high performance and improved safety, when compared to popular in portable devices liquid-based Li-ion batteries. Safety of classical Li-ion battery cell can be compromised on certain events as they contain flammable and corrosive liquids. One strategy to improve safety of the battery cell is to replace all liquid components with their solid-state counterparts, in particular made of ceramic materials. Such batteries, using only ceramic components, are safer than liquid-based, as Li-ions are bound into the crystal structure, can be operated at higher than classical batteries temperatures, allow to use new high-capacity and high-voltage electrode materials and can be miniaturized and on-chip integrated with personal and wearable electronics. One of the main challenges to fabricate efficient solid-state battery is relatively high resistance of the electrolyte layer.

In this project we focus on the development and characterization of new ceramic electrolyte materials for all-solid-state Li-ion batteries. We will prepare new ceramic electrolytes based on Li-garnets prepared by the doping strategy and characterize their crystal structure and charge transport mechanisms, to understand the role of the defects on Li-ionic conductivity. Classical approach to the doping study is, however, time and resource-consuming task, therefore we propose in this project novel method of fast optimization of the type and the amount of the dopant required for optimal Li^+ conductivity and materials stability to understand fundamental mechanisms ruling ionic transport in Li-garnets. For this purpose, a wide range of advanced characterization methods that allow both local and long-range structure to be elucidated will be used. This will help to establish just how these materials conduct and how Li- conductivity can be enhanced. This will aid the development of new oxide ion conductors for advanced electrochemical devices solid state batteries and gas sensors.