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All-solid state Li-ion batteries with ceramic electrolyte

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Today battery safety is one of the main problems blocking the market of electric vehicles. Toxic and flammable liquid electrolytes are responsible for most of the safety incidents including electrolyte leakage, ignition and cell explosion. It is critical to address such safety concerns when scaling up the battery size for use in electric transport and stationary applications. Solid lithium-ion conductors have granted much attention as candidates to replace liquid electrolytes in Li-ion batteries due to the following possible advantages: non-flammability, non-reactivity, higher thermal stability, absence of leakage, large electrochemical window, ease of miniaturization and excellent storage stability. However, solid-state Li-ion batteries have their issues: low ionic conductivity, difficult implementation and volume changes are some of the reported limitations. CEA LITEN has a broad experience in development of conventional Li-ion cells with liquid electrolyte. The studies of solid electrolyte implementation have been initiated to meet the demands of car-makers. Nowadays, a number of techniques have been reported in literature to incorporate solid electrolyte into the Li cell but still there is no commercial product. The main problems are the interfacial resistance due to poor contact between particles, chemical and electrochemical interactions between components of the cell. Our lab develops ceramic and glassy solid electrolytes to improve the battery safety and employ advanced electrode active materials. One of the amitious targets is to adapt the approaches from the world of ceramics to create a «one stone» dense Li-ion cell. In this study, two aspects of solid electrolyte implementation will be discussed: one relates to conductive membrane stabilization; another deals with composite electrodes. Ceramic $Li_7La_3Zr_2O_{12}$ having a garnet structure and softer $Li_{10}SnP_2S_{12}$ are used as a solid electrolytes. These electrolytes have different physical properties which allows using different implementation methods.

Biography

Vasily Tarnopolskiy has completed his PhD in 2003 from Russian Academy of Sciences and Post-doctoral studies from Samsung SDI (S. Korea), Muenster University (Germany) and CEA (France). His interests include lithium-ion batteries, high-voltage cathodes, solid electrolytes, all-solid Li cells.

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