Solid State Lithium Batteries: Past, Present and Future

A. Mauger [1], C.M. Julien [1], M. Armand [2], J.B. Goodenough [3] and K. Zaghib[4]*

[1] *Sorbonne Universités, UPMC Univ Paris 06, Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie (IMPMC), CNRS UMR 7590, 4 place Jussieu, 75005 Paris, France*

[2] *CIC Energigune, Parque Tecnologico de Alava, Albert Einstein 48, Ed. CIC, 01510 Miñano, Spain*

[3] *Texas Materials Institute, The University of Texas at Austin, 1 University Station, C2201, Austin, TX 78712, USA*

[4] *Centre of Excellence in Transportation Electrification and Energy Storage (CETEES), Hydro-Québec, 1806, boul. Lionel-Boulet, Varennes Quebec, Canada J3X 1S1*

**corresponding author; zaghib.karim@ireq.ca*

HQ started work on lithium metal with polymer electrolyte in lithium rechargeable batteries in 1979. Since that time, battery research has expanded worldwide. Several new polymers, solid electrolytes and ionic liquids with improved conductivity have resulted from a better understanding of the major parameters controlling ion migration, such as favorable polymer structure, phase diagram between solvating polymer and lithium salt, and the development of new lithium counter-anions. In spite of the progress so far, the quest for a highly conductive dry polymer at room temperature is still continuing and all-lithium polymer battery (LPB) developers presently face the challenge of whether to heat the polymer electrolyte to enable high-power performance, as required for electric vehicle and energy storage. LPB developers have explored both the high-temperature and low-temperature options.

This presentation provides an overview and progress in developing three battery technologies:

1. Lithium-metal-based batteries made from dry polymer and ionic liquid-polymer electrolytes for rechargeable lithium batteries with olivine ($LiMM'PO_4$).
2. All solid-state batteries using Li-NMC or rich Ni.
3. High voltage (polymer, polymer- ceramic, polymer-glass) solid state batteries.