



# Advanced Solid State Li-Ion Battery

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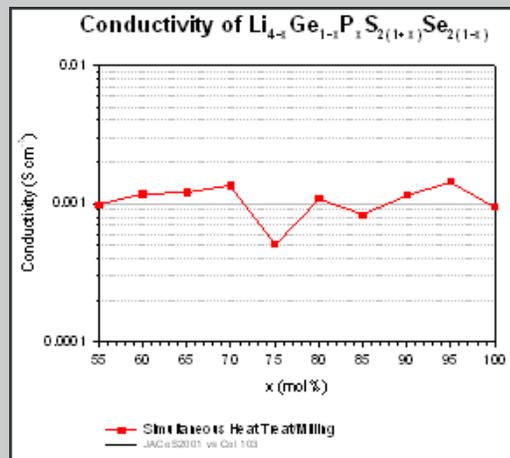
## Background

Research on all-solid-state rechargeable lithium batteries has increased considerably in recent years due to raised concerns relating to safety hazards such as solvent leakage and flammability of liquid electrolytes used for commercial lithium-ion batteries. As solid state electrolytes do not carry the safety burdens of liquid electrolytes and are more effective, an effort is under way to produce a viable substitute solid electrolyte to replace conventional liquid electrolytes. Yet another remarkable feature of solid electrolytes in addition to all of the previously stated advantages is that only Li<sup>+</sup> ions are mobile in them. With this exclusivity to Li<sup>+</sup> ions, side reactions are minimized along with capacity fading and self-discharge. Unfortunately current research has yet to unveil a solid state electrolyte that can outperform liquid electrolyte. Inferior rate capability, low ionic conductivity, interfacial instability, and low loading of active materials are just a few of the barriers that stand in the way of solid state electrolyte commercialization.

Ball milling has recently emerged as a promising and relatively low cost method for solid state electrolyte development. This technique has proven useful for generating ultra-fine amorphous materials that function well for achieving high ionic conductivities as well as close contact between electrolyte and electrode materials for all-solid-state cells. Ball milled amorphous powders are often heat treated to attain a crystalline structure capable of even higher conductivities than those reached by amorphous powders. However, this can only be achieved by a two step that is time consuming and inefficient.

## Technology

A research team at the University of Colorado at Boulder led by Se-Hee Lee has developed an advanced system for preparation of electrodes for use in a solid state lithium-ion battery. The process involves a single step, high energy ball milling system (SSBM) with simultaneous heating to produce a crystalline electrolyte of silicon nanoparticles. The silicon nanopowder showed superior conductivity and outstanding cycling stability. This novel method is a superior technique for developing solid state electrolytes for use in all-solid-state batteries.



## Key Documents

“System and Method for the Preparation of Crystalline Solid State Electrolyte and Its Use in a Solid-State Battery with a Solid-State Silicon Anode.” Provisional patent application filed July 10, 2010; available under CDA.

[Glass-ceramic Li<sub>2</sub>S-P<sub>2</sub>S<sub>5</sub> electrolytes prepared by a single step ball milling process and their application for all-solid-state lithium-ion batteries.](#) Electrochemistry Comm. 2009 Sept; 11(9):1830-33. PDF available upon request.