By nanostructuring the previously reported lithium ion conductor Li3PS4, we demonstrated that lithium-ion conductivity at room temperature could be improved roughly 1000 times over the natural material. We applied two nanotechnology-based approaches: nanoscale porosity to increase surface area; and stabilization of a high-temperature phase at room temperature using nanoscale grain sizes. The first approach is useful to increase ion conduction along surfaces. The second approach is a well known effect of reduced grain size, which can prompt a change in crystal symmetry based on relative surface energy to bulk energy ratios.

The material we demonstrate has several important features beyond ion conductivity. First, the material is stable to 5V, and stable against lithium metal, making it an ideal candidate for constructing metal anode batteries. Second, the material is made at large batch sizes (100 g per batch) in a low cost manner which we predict should be highly scalable. Thirdly, as a solid electrolyte this material can be used in lithium-sulfur cells as a separator, minimizing the sulfur shuttle mechanism, in which by capacity fades as a result of the irreversible oxidation of sulfur active material during cycling.

Reference:
“Anomalous High Ionic Conductivity of Nanoporous β-Li3PS4,”
Z. Liu,† W. Fu,† E. A. Payzant,‡ X. Yu,† Z. Wu,† N. J. Dudney,‡ J. Kiggans,‡ K. Hong,† A. J. Rondinone,† and C. Liang*,†
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