How to Design Solid Electrolytes for High Energy Density Lithium Ion Batteries

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A wide range of inorganic metal oxides, non-metal oxides, organic polymers, and inorganic-organic hybrid materials exhibit fast Li ion conduction of about 10^{-6}-10^{-3} S/cm at room temperature. Ceramic electrolytes show Li ion transference numbers close to unity, while the organic polymer-based electrolytes exhibit a much lower value. The chemical stability of ceramic electrolytes with Li electrodes, especially at high temperatures, makes them more attractive over conventional polymer systems. The key requirements for useful solid Li ion electrolytes not only include high ionic conductivity and negligible electronic conductivity, but also chemically stability both at the anodic and cathodic environments. They must also allow movement of Li ions between electrode and electrolyte interfaces, which remain a challenge since several known materials tend to form reaction products at the interfaces. In this presentation, the authors will report novel inorganic materials that are chemically stable with Li electrodes and show promise for the next generation of Li air batteries and conventional intercalation compound based Li batteries.