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LECTURE

"Designing Nanostructured Single-ion Polymer Electrolytes at the Macromolecular Level for Lithium Metal Batteries"

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Single-ion solid polymer electrolytes (SI-SPEs) represent the ultimate solution to the safety issues associated with the use of flammable and toxic liquid electrolytes in commercial Li-ion batteries. Most importantly, SI-SPEs hold the key for the realization of high energy-density Li-metal batteries, as they are chemical stable towards Li metal while their mechanical resistance could reduce, or even suppress Li dendrite formation and eliminate the associated safety hazards and the catastrophic failure of the battery. Despite the considerable research effort in SI-SPEs, the development and realization of their potential has been hampered by the inability to design materials that possess simultaneously, high ionic conductivity, good mechanical properties, and cation transference number close to unity. In this talk, I will outline our recent research effort towards the design of high-performance SI-SPEs. In particular, I will introduce the use of novel, stiff/glassy, polyanion nanostructured polymer particles, as (i) single-component nanostructured materials where the entire SI-SPEs will be created by the nanoparticle as building blocks and (ii) as additives to liquid, low molecular weight fast conducting polymer electrolytes. As it will be discussed during the talk, the proposed macromolecular design approach offers new means to control the morphology of SI-SPEs and to decouple and tune the antagonistic properties of ion-conductivity and shear modulus, which currently limits the realization of single-ion polymer electrolytes in lithium metal batteries.

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