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How does crystalline structure affect ionic conductivity in solid polymer electrolyte? SHAN CHENG, DERRICK SMITH, CHRISTOPHER LI, Drexel University — Solid polymer electrolytes (SPEs) have drawn intensive attention due to their potential applications in all-solid-state lithium batteries. Ion conduction in this system is generally considered to be confined in the amorphous polymer/ion phase and through segmental motion assisted hopping. In poly(ethylene oxide) (PEO) based SPEs, the crystalline nature of the polymer complicates the ion transport behavior. Herein we quantitatively show that the effect of polymer crystallinity on ion transport is two-fold: one is structural (tortuosity) and the other is dynamic (tethered chain confinement). We decouple these two effects by designing, and fabricating a model polymer single crystal electrolyte system with controlled crystal structure, size, crystallinity and orientation. The tortuosity effect results in a high conductivity anisotropy (10^2 -10^3) from directions parallel and transverse to PEO crystal lamellae. On the other hand, the dynamic effect is negligible at relatively high ion content, suggesting that semicrystalline polymer is a valid system for practical polymer electrolytes design.

Shan Cheng
Drexel University

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