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DI PADOVA

POLY-VOLT - POLYmer-grafted nanoparticles for improVing cycle life Of Lithium baTteries

Lithium metal batteries (LMBs) are the most prominent, higher-energy alternative to conventional Li ion batteries, but face commercialization problems primarily associated to the growth of Li dendrites, which causes premature device failure. A promising approach to mitigate dendritic growth involves the deployment of polymeric solid-state electrolytes (SSEs). In these systems, inorganic nanoparticles (NPs) are often dispersed within polymer matrixes to improve mechanical properties and reduce crystallinity, thus increasing ionic conductivity. However, NPs tend to agglomerate, creating heterogeneities that decrease performance and promote dendritic growth.

In POLY-VOLT, polymer chains will be covalently grafted onto inorganic surfaces forming polymer-grafted nanoparticles (PGNs) where polymer crystallinity and NP agglomeration are simultaneously suppressed, maximizing the advantages of combining polymer and inorganic fillers in SSEs. Additionally, PGNs present the unique advantage of fully tailorable structural parameters, such as the density of grafted polymer chains and their molar masses. Thus, these parameters will be finely tuned to form a library of PGN SSEs and comprehensively dissect the effect of structural features on conformation, segmental motion, Li ion transport, and mechanical strength. These properties will then be correlated to cycling stability and dendritic growth in LMBs. The library will comprise polymer grafts containing ethylene oxide and/or ethylene imine units. Indeed, the distinct architecture of PGNs will enable to overcome the crystallinity issue that limit the use of poly(ethylene imine)s in SSEs, thus exploiting the high coordination ability of N atoms, opening new avenues for N-rich electrolytes. POLY-VOLT will therefore considerably advance the field of SSEs, accelerating the development of reliable LMBs and the transition to greener technologies, responding to the urgent demands of the EU Green Deal.

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