MOF GLASS BASED SOLID-STATE POLYMER ELECTROLYTE FOR LITHIUM METAL BATTERIES

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Polymer solid-state electrolytes are promising candidates for solid-state lithium metal batteries, but fillers play a very critical role in adjusting their network structure, electrochemical properties, thermal stability, and mechanical properties. However, most of the fillers reported so far are anisotropic, which limits the potential to enable isotropic ion transport. Here, we prepare polyethylene oxide (PEO) based solid-state electrolytes using a metal-organic framework (MOF) glass (namely ZIF-62 glass) as an isotropic functional filler. Calorimetric and diffusion kinetics tests show that the MOF glass addition reduces the glass transition temperature of the polymer phase, improving the mobility of the polymer chains, and thereby facilitating Li-ion transport. By also incorporating a lithium salt (LiTFSI) and ionic liquid (IL), Li-Li symmetric cell tests of the PEO-LiTFSI-MOF glass-IL electrolyte reveal low overpotential, indicating low interfacial impedance. Molecular dynamics simulations show that the isotropic structure of the MOF glass facilitates wettability of the ionic liquid by enhancing interfacial interactions, leading to a less confined ionic liquid structure that promotes Li-ion mobility. Finally, the PEO-LiTFSI-MOF glass-IL electrolyte is used to construct Li-Li iron phosphate full batteries that feature high cycle stability and rate capability.

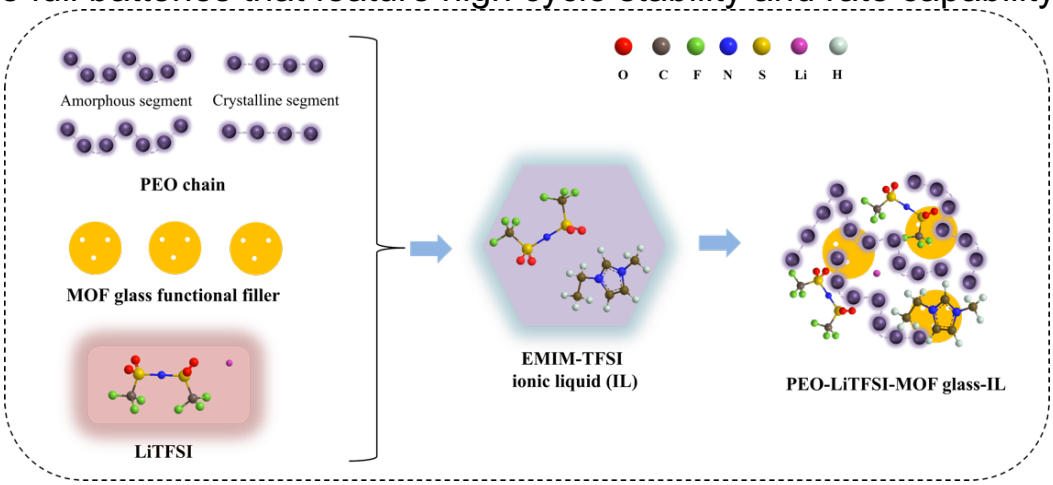

Figure 1. Schematic diagram of the preparation of MOF glass functional filler based solid-state polymer electrolytes with IL.

Keywords: MOF glass, functional filler, solid-state polymer electrolyte, ionic liquid, lithium metal batteries