Organic-inorganic hybrid polysilsesquioxane ionogel electrolyte for energy storage devices

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Hybrid ionogels fabricated with 1M LiTFSI in *N*-butyl-*N*-methylpyrrolidinium bis(trifluoromethylsulfonyl)imide (BMPYTFSI) crosslinked with a ladder-like structured poly(methacryloxypropyl)silsesquioxane (LPMASQ) were investigated as high temperature gel polymer electrolytes for lithium ion batteries. In addition to the exceeding low crosslinker concentration (~2 wt %) required to completely solidify the ionic liquids which allowed for high ionic conductivities comparable to the liquid state ionic liquid (~0.5 mS/cm), these hybrid ionogels exhibited superior thermal stabilities (> 400 °C). Lithium ion battery cells fabricated with these gel polymer electrolytes at various C-rates at various temperatures showed almost same cell performance as the cells with liquid electrolyte. Moreover, these hybrid ionogels exhibited excellent cycling performance after 100 cycles at 90 °C, sustaining over 98 % coulombic efficiency, while conventional organic crosslinking agents suffered from thermal degradation and subsequent cell failure. Highly advantageous properties of these hybrid ionogels, such as high ionic conductivity in the gel state, thermal stability, excellent C-rate performance, cyclability, and nonflamability offer opportunities for applications as high temperature electrolytes.

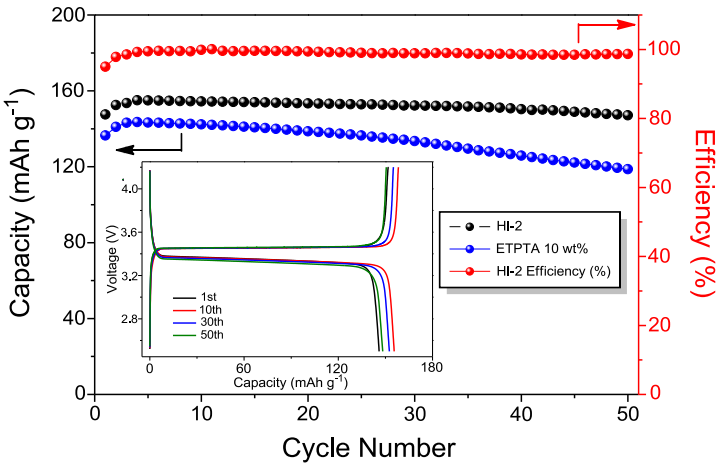

Figure 1. Cyclability of HI-2 ionogel compared with a conventional organic ionogel fabricated with ETPTA, with the inset figure showing the representative discharge profiles

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