A Sandwich-Structure Composite Membrane as Separator with High Wettability and Thermal Properties for Advanced Lithium-Ion Batteries

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Lithium-ion batteries with high energy density and environmental friendliness have attracted considerable interest for researchers in recent years. However, the conventional polyolefin separators with poor electrolyte wettability and low thermal stability limited the further development of lithium-ion batteries. Here we designed a porous poly(m-phenylene isophthalamide) (PMIA) layer, embedded with high-dispersed TiO₂-P(MMA-AA-BA) (TP) nanohybrid, on both sides of a polyethylene (PE) membrane by a facile nonsolvent-induced phase inversion process to improve the electrolyte wettability and thermal stability of the PE separator. The TP nanoparticles can disperse uniformly in PMIA layer. Due to the inherent high-heat resistance and good affinity to the liquid electrolyte of PMIA and nanohybrid, this (TP-PMIA)-modified PE (TP-PMIA@PE) membrane exhibits high porosity, high ionic conductivity, improved thermal resistance and superior interfacial stability, which can endow the composite membrane-based Li/LiFePO₄ cell with good capacity retention and superior rate capability. The as-prepared composite membrane can serve as a promising separator for high-safety and high-performance lithium-ion batteries.

Keywords: Poly (m-phenylene isophthalamide); Nanohybrid ; Phase inversion process; Separator; Lithium-ion batteries

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