

Dual Crosslinked Ionogel Electrolyte for Flexible Energy Storage Devices

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Amongst functional gels, gel electrolytes have been considered to resolve critical challenges of both liquid and solid electrolytes; however, they suffer from the same trade-off as existing electrolytes between ion transport and mechanical properties, as well as the dilemma of common gels between strength and toughness. Here, we demonstrate highly ion-conducting, stretchable, and ultradurable double network (DN) ionogel films, in which ionic liquids (ILs) are confined in chemically-coupled complementary DN consisting of hard and soft polymers. When the temperature is increased from 30 to 100 °C, the DN ionogel film demonstrates excellent properties, such as ionic conductivities from 1.8 to 102 mS cm⁻¹, a potential window of 2 V, tensile strengths from 3.2 to 1.7 MPa. Thus, the DN ionogel-based, high temperature flexible supercapacitors (hfSCs) achieve the higher energy and power densities of 25 Wh kg⁻¹ and 8.2 kW kg⁻¹ at 180 °C. Their multifunctionality and extreme durability are further confirmed at both elevated temperatures and in bent states, demonstrating a capacitance retention of ~80 % over 100000 cycles.