Metal-doping Strategy for High-Performance Electrochromic Supercapacitors Based on Polymeric Ion Gels

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Herein, high-performance, reliable electrochromic supercapacitors (ECSs) are proposed based on tungsten oxide (WO_3) and nickel oxide (NiO) films. To maximize device performance and stability, the stoichiometric balance between anode and cathode materials is controlled by adjusting the thickness of the anodic NiO film while fixing the thickness of WO_3 to ~660 nm. Then, a small amount (≤10 mol %) of metal (e.g., copper) is doped into the NiO film, improving the conductivity and electrochemical activity. At a Cu doping level of 7 mol %, the resulting ECS exhibited the highest performance, including a high areal capacitance (~14.9 mF/cm^2), excellent coulombic efficiency (~99%), wide operating temperature range (0–80 °C), reliable operation with high cyclic stability (> 10,000 cycles), and good self-discharging durability. Simultaneously, the transmittance change of the device is well synchronized with the GCD curve by which the real-time energy storage status is visually indicated.