Understanding the Diffusion-Controlled Driving Mechanism of All-in-One Type Electrochromic Supercapacitors

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All-in-one electrochromic supercapacitors (ECSs) based on a single electrochromic (EC) gel layer are an attractive electronic component owing to their structural simplicity and capacitive and EC dual-function. Particularly, the correlation between EC gel properties and ECS performance has not been properly established. The charging-discharging behaviors of ECSs based on conventional ion gels consisting of copolymer gelators and ionic liquids are incomplete due to the slow device dynamics arising from the delayed mass transport of redox-active materials through diffusive motion. Therefore, we propose ternary gel electrolytes (TGEs) containing small organic molecules to reduce the overall viscosity and enlarge the free volume in the gel. A sufficient redox species can participate in galvanostatic charging-discharging reactions when the all-in-one ECSs are fabricated with highly conductive and elastic TGEs, resulting in a 3.3-times higher capacity than those based on typical ion gels. Moreover, the TGE-based devices overcome the trade-off between transmittance contrast and response time, leading to superb performance.