High Performance of Solid-State Flexible Asymmetric Supercapacitor Based on Graphene Films

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Solid-state flexible energy storage devices hold the key to realizing portable and flexible electronic devices. Achieving fully flexible energy storage devices requires that all of the essential components with specific electrochemical and interfacial properties are integrated into a single solid-state and mechanically flexible unit. We describe the fabrication of solid-state flexible asymmetric supercapacitors based on ionic liquid functionalized-chemically modified graphene (IL-CMG) film (as the negative electrode) and hydrous RuO2/IL-CMG composite film (as the positive electrode), separated with a polyvinyl alcohol/H2SO4 electrolyte. The highly ordered macroscopic layer structures of these films arising through direct flow self-assembly make them simultaneously excellent electrical conductors and mechanical supports, allowing them to serve as flexible electrodes and current collectors in supercapacitor devices. Our asymmetric supercapacitors have been optimized with a maximum cell voltage up to 1.8 V and deliver a high energy density (19.7 W•h kg–1) and power density (6.8 kW g–1); higher than those of symmetric supercapacitors based on IL-CMG films.