Carbon Frameworks for Supercapacitor with High Energy Density

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Abstract

The design of high-voltage supercapacitors has been considered as an effective strategy for improving the energy density, which can be achieved easily by selecting a suitable electrolyte with a wide potential window. Ionic liquids (ILs) electrolyte has attracted tremendous attention due to their high voltage window (> 4.0 V), good temperature stability and chemical inertness. However, ILs are severely tortured by their intrinsic large ion size, high viscosity and sluggish diffusion kinetics. It is necessary to develop ideal carbon electrode materials possessing high compatibility with ILs electrolyte to deliver high energy density without sacrificing the high power density, long lifetimes and rapid charge-discharge rate. Herein, a facile gas-blowing strategy is proposed to prepare 3D carbon frameworks consisting of carbon nanosheets. The as-obtained carbon materials show great compatibility in 4V $EMIBF_4$ ILs electrolyte toward high energy power density (53.3 Wh kg^{-1} is achieved at 51 kW kg^{-1}). Furthermore, it has excellent frequency response with an ultrahigh charge-discharge rate up to 2 V s^{-1}, which demonstrates that 3D carbon architectures have matchable pore size distribution, suitable ion-diffusion channels and high affinity to ILs.

Keywords: Supercapacitors; Carbon frameworks; Ionic liquids; High energy density