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Self-Assembly-Template Engineering Nitrogen-Doped Carbon Aerogels for High-Rate Supercapacitors

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Abstract

Three-dimensional (3D) interconnected porous nitrogen-doped carbon aerogels (CAs) have successfully prepared with polyvinyl alcohol and nitrogen-containing Nbeen phenylethanolamine as carbon and in-situ nitrogen sources, and boric acid as both crosslinking agent and 3D self-template. After drying, carbonization and KOH-activation treatment, the as-obtained CAs exhibit large specific surface area, hierarchically porous structure, heteroatom doping and superhydrophilicity. The optimal sample shows a high surface area up to 2016 m² g⁻¹ with a total pore volume of 1.179 cm³ g⁻¹. The synergistic effect of the reasonably hierarchical porosity, high effective surface area utilization, superhydrophilicity, and heteroatom pseudocapacitance are in favor of high specific capacitance of 467 F g^{-1} in three-electrode system and considerable cycle performance of 85.7 %, 90.9 % retention over 10,000 cycles at 20 A g^{-1} and 30 A g^{-1} . Moreover, the symmetric supercapacitor configuration delivers an energy density of 22.75 Wh kg⁻¹ at power density of 262.5 W kg⁻¹ and 7.6 Wh kg⁻¹ at power density of 9572 W kg⁻¹. Here, we pioneer an in-situ self-template approach for fabricating hierarchically porous aerogels with a potential application in supplying a peak power for hybrid electric vehicles, memory backup systems, cold-starting assistants and especially electrochromic devices as demonstrated in our case.

Keywords: Carbon Aerogel; Self-assembly Template; Nitrogen Doping; Supercapacitor

1. Introduction

Carbon aerogels (CAs), a unique class of nanoporous and amorphous carbon material, inherit the network structure and lightweight characteristics of organic aerogels **and display**

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