Synthesis of hierarchically structured partially graphitized carbon by emulsion/block-copolymer co-template and its application for supercapacitor

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Hierarchical structures which contain macropores, mesopores, and micropores can significantly improve the rate performance of the device. However, formation of well-distributed macropores generally requires pre-formed hard template such as silica particles or polymer beads. These templates increase the cost and complexity of the synthesizing procedure. In this work, we developed a novel method that synthesizes hierarchically structured macro/mesoporous partially graphitized carbon (MMPGC) without any pre-formed hard template. This procedure employed co-template of emulsion and block-copolymer which generate macropores and mesopores, respectively. The procedure consists of very simple steps including mixing in solution phase, carbonization, and acid leaching. In addition to hierarchical pore structure, MMPGC has a partially graphitized framework derived from cobalt graphitization catalyst. When this material was applied as a supercapacitor electrode material, it exhibited much enhanced rate performance as compared to commercial activated carbon and ordered mesoporous carbon which was synthesized with mesoporous silica hard template. Electrochemical impedance spectroscopy also revealed that MMPGC has very small resistance as a supercapacitor electrode, especially in terms of charge transfer and mass transport.