Fabrication of Cu$_2$O/Ni core-shell inverse opal electrodes with three-dimensionally ordered macroporous for high capacitance supercapacitors

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Nanomaterials for supercapacitors attract much attention because they can improve the power capabilities and life cycles of supercapacitors through their large surface area. In a nano-structured electrode, the distance within the material over which electrolyte ions must transport is smaller, and the larger surface area allows for a greater current density during charging and discharging. Here we report an ordered polystyrene (PS) template-assisted electrochemical approach with which we synthesized three-dimensional ordered macroporous (3DOM) Cu$_2$O/Ni inverse opals as electrodes for supercapacitor applications. The electrode nano-architecture can potentially improve power density in two ways: the 3DOM Ni substrate is expected to result in greater electrical conductivity than for a conventional disordered metal-oxide electrode, and the periodic pore structure inherent in ordered inverse opals might allow greater ionic conduction in the electrolyte-filled pores than for the circuitous pore structure in disordered metal-oxide electrodes. The 3DOM Cu$_2$O/Ni electrodes display superior kinetic performance, and satisfactory rate capability and cycling performance. The electrochemical characteristics of the resulting 3DOM Cu$_2$O/Ni architecture are then examined as a new design for pseudocapacitor electrodes.