Direct Formation of Reduced Graphene Oxide and Graphene Quantum dot Composites by Using Ascorbic Acid as High-Performance Binder-Free Supercapacitor Electrodes

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With unique structural features and hydrophilic functional groups, graphene quantum dots (GQDs) and graphene oxide (GO) are potential materials for supercapacitor electrodes. In this work, GQDs decorated with a GO hybrid and an interconnected nickel network are successfully fabricated and subjected to reduction treatment with ascorbic acid. GO and GQD composites (GO/GQDs) exhibit with different mass ratios of GO to GQDs (6:1, 3:1, 1:1) are also investigated. The specific capacitance (Csp) of the reduced GO (rGO)/GQD composites is higher than that of rGO. Among the composites with different mass ratios, the rGO/GQD composites with GO:GQDs=3:1 exhibit the highest electrochemical performance because the intercalation of GQDs into GO nanosheets can promote electron transportation and thus reduce the internal resistance and charge transfer resistance of the electrode. Additionally, the GQDs with large specific surface area can enhance the interfacial property among GO. It yields a Csp of 296 F g⁻¹ at a current density of 0.5 A g⁻¹ and 85% retention after 3,000 cycles of charge/discharge. Csp remarkably decreases when the mass ratio of GO to GQDs increases to 1:1 possibly because of blocked ion channels from a large amount of GQDs loaded on the GO surface.

Keywords: Graphene oxide quantum dots, Graphene oxide, Reduction, Supercapacitors, Composites

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