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Compact, Flexible Conducting Polymer/Graphene Nanocomposites for High Volumetric Supercapacitors

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ABSTRACT

Graphene is extensively utilized in energy storage devices because of its high surface area and electron conductivity as well as ease of electrode fabrication. But graphene sheets often stack themselves in polymeric matrices leading to poor capacitive performance. This problem was addressed in this study by developing and inserting respectively two types of nano-sized conducting polymers into graphene interlayer spacing. The resulting hydrogel composite electrodes demonstrated efficient electron transfer for fast and reversible Faradaic reactions at the interface. Theoretical modelling by the density functional theory suggested that the reduction involve $2H^+$ transfer steps from polyaniline to graphene oxide: the first step would be an epoxy-ring opening process after activation of the C–O bond, and the second step would be C–O rupture leading to a de-epoxidation process. This binder-free electrode demonstrated high cycling performance and ultrahigh volumetric capacitance 612 F cm^{-3}, being 10 times higher than the activated carbon used in the current industry. The