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Illustrating the effect of electron withdrawing and electron donating groups adherent to *p*-hydroquinone on supercapacitor performance: the cases of sulfonic acid and methoxyl groups

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Abstract

Illustrating the roles of electron withdrawing/donating groups upon the capacitive behaviors of *p*-hydroquinone (PHQ) can benefit for achieving superior supercapacitors. In present work, sulfonic acid and methoxyl group are adopted as electron withdrawing group (EWG) and electron donating group (EDG), respectively, that is, the substances of 2,5-dihydroxybenzenesulfonate (DHBS) and 2-methoxyhydroquinone (MHQ). It is revealed that PHQ, DHBS and MHQ can serve as effective redox additives in H_2SO_4 electrolyte, and two-proton/two-electron redox reactions occur at the electrode-electrolyte interface. DHBS exerts higher faradaic effect than that of MHQ, implying the EWG is more active than the EDG when adhered to PHQ. Furthermore, from the point of kinetics, all the relevant redox processes are limited by semi-infinite diffusion. And high energy density of 15.6 Wh kg^{-1} is obtained towards the DHBS sample with concentration of 2 mmol L^{-1} when measured in 1 mol L^{-1} H_2SO_4. The present work would favors for understanding other supercapacitor systems possessing electron withdrawing/donating groups.

Keywords: Electron withdrawing group; Electron donating group; *p*-Hydroquinone; Redox additive; Supercapacitor.