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Improving biomass-derived carbon by activation with nitrogen and cobalt for supercapacitors and oxygen reduction reaction

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Abstract

Biomass-derived carbon by activation with nitrogen and cobalt (denoted as $NPAC_{Co}$) was prepared by one-pot pyrolysis of pomelo peel with melamine, cobalt nitrate and potassium hydroxide, followed by acid leaching. $NPAC_{Co}$ possesses high content of quaternary-N (2.5%) and pyridinic-N (1.7%), co-existences of amorphous and short-range ordered carbon, high specific surface area and pore structure with majority of micropores and small mesopores. As electrode material of supercapacitors, $NPAC_{Co}$ exhibits high specific capacitance and good rate capability. At ultrahigh rate of 50 A g^{-1} (135 mA cm^{-2}), the capacitance of $NPAC_{Co}$ remains 246 F g^{-1}, which is 6.3, 1.9 and 3.2 times as high as that of other three materials (PC, PAC and NPAC). The as-assembled symmetric supercapacitor of $NPAC_{Co}$ delivers high energy density, high power density and excellent cycling stability. With respect to oxygen reduction reaction (ORR), $NPAC_{Co}$ exhibits high onset potential (0.87 V), high half-wave potential (0.78 V), excellent methanol tolerance and low yield of