3D Binder-free N-doped carbon /CNTs/FCP for high electrochemical capacitance supercapacitor
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The binder-free flexible carbon paper (FCP) supported mutil-wall carbon nanotubes (CNTs) were synthesized via hydrocarbon pyrolysis while Ni nanoparticles was in-situ generated and dispersed on the surface of carbon paper as catalysts. Subsequently, polyaniline was deposited on the surface of CNTs/FCP by pulse galvanostatic method (PGM), which was followed by polyaniline carbonization and KOH activation to obtain nitrogen-doped (N-doped) carbon/CNTs/FCP composite. The Raman spectroscopy, scanning electron microscope (SEM), transmission electron microscope (TEM) investigation indicated that N-doped carbon/ CNTs/FCP was formed after the polyaniline carbonization and KOH activation, without destroying the intrinsic CNTs structure. Due to its nitrogen functional groups and 3D dimensional structure, N-doped carbon/CNTs/FCP exhibited good hydrophilicity and high electrochemical capacitance in aqueous solution. Compared to the pristine CNTs/FCP, of which the specific capacitance($C_P$) was 5.23 F/g and 8.24 F/g in 1M H$_2$SO$_4$ and 0.5M KOH solution respectively, the reversible $C_P$ of N-doped carbon/CNTs/FCP reached 193.3 F/g (1M H$_2$SO$_4$) and 161.0 F/g (0.5M KOH), at the current density of 1 A/g. Moreover, this N-doped carbon/CNTs/FCP also shows excellent cycling performance with little capacitance loss over long term galvanostatic charge-discharge, which is a promising electrode material for supercapacitor application.

References

Fig. 1. Cyclic voltammograms of the FCP, CNTs/FCP, N-doped carbon/CNTs/FCP at scan rate of 5mv/s in 1M H$_2$SO$_4$ solution

Fig. 2. Cyclic voltammograms of the FCP, CNTs/FCP, N-doped carbon/CNTs/FCP at scan rate of 5mv/s in 0.5M KOH solution

Fig. 3. The cycle performance of N-doped carbon/CNTs/FCP composite electrode ,the electrolyte is 1M H$_2$SO$_4$ and 0.5M KOH respectively