Electronic Supplementary Information (ESI) for

Effects of electrolytes on the capacitive behaviors of nitrogen/phosphorus co-doped nonporous carbon nanofibers: Insight into the role of phosphorus groups

Xiaodong Yan, Yunhua Yu* and Xiaoping Yang

State Key Laboratory of Organic-Inorganic Composites, Beijing University of Chemical Technology, Beijing 100029, China

Experimental details

1. Fabrication of N/P-NPCNFs

The fabrication of N/P-NPCNFs was according to our previous method.[1] Typically, 2.0 g PAN (M_w=100,000 g mol^{-1}, UK Courtaulds Co.) and 0.4 g phosphoric acid (H_3PO_4, 85 wt% in water, Beijing Chemical Co.) were dissolved into 16 mL N, N-dimethyl formamide (DMF, Beijing Chemical Co.). Then electrospinning was carried out at an electrostatic voltage of 16 kV. The as-prepared nanofiber webs were stabilized at 280 °C for 2 h with a heating rate of 3 °C min^{-1} in air, and subsequently carbonized at 800 °C for 2 h with the ramping rate of 5 °C min^{-1} in nitrogen. The sample was denoted as N/P-NPCNFs. For comparison, pure carbon nanofibers (N-NPCNFs) derived from pure PAN were prepared under the same conditions.

2.2. Characterization

The morphology of the precursor nanofibers was characterized by a field emission scanning electron microscope (FE-SEM, Supra55, Carl Zeiss). The X-ray photoelectron spectroscopy (XPS, EscaLab 250, Thermo Fisher Scientific) was used to investigate the surface chemistry.

2.3. Electrochemical measurements

To prepare the electrodes, a mixture of the sample and polyvinylidene fluoride binder with the weight percent ratio of 90:10 was dispersed in 1-Methyl-2-pyrrolidone, and then the slurry was coated on the platinum current collectors. Afterwards, the electrodes were dried in a vacuum oven at 120 °C for 24 h. The loading mass of the active materials on each platinum plate was ~ 3.0 mg cm^{-2}. The electrochemical measurements were carried out in a three-electrode system with a reference electrode of Ag/AgCl and a counter electrode of platinum plate in different electrolytes (1 M H_2SO_4, 0.5 M Li_2SO_4, 1 M Na_2SO_4 and 0.5 M K_2SO_4). Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) measurements were carried out on an electrochemical workstation (Autolab PGSTAT 302N, Metrohm). The galvanostatic charge/discharge processes were conducted on a LAND CT2001A battery tester.

References

[1] X. Yan, Y. Liu, X. Fan, X. Jia, Y. Yu and X. Yang, J. Power Sources, 2014, 248, 745.