Electronic Supplementary Material (ESI) for RSC Advances

Supporting Information

Peapod-like Nickel@mesoporous carbon core-shell nanowires: a novel electrode material for supercapacitors

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Part I: Experimental Section

Characterizations: The as-prepared products were characterized with X-ray powder diffractometer (XRD; Shimadzu XRD-6000, Cu Kα radiation) at a scan rate of 2 °C min^{-1}, scanning electron microscopy (FESEM; JEOL, JSM-7600F) equipped, and transmission electron microscopy (TEM; JEOL, JEM-2100F) operated at 200 kV. N_2 adsorption/desorption was determined by Brunauer-Emmett-Teller (BET) measurements using an Tristar-3000 surface area analyzer.

Electrochemical measurements: The electrochemical measurements (Autolab PGSTAT30 potentiostat) were conducted using a three-electrode mode in a 1 M KOH aqueous solution. The working electrodes were prepared by mixing the active materials (90 wt%) and polyvinylidene fluoride (PVDF, 10 wt.%) in NMP. A small amount of absolute ethanol was then added to the mixture to promote homogeneity. After that, the mixture was coated onto the graphite paper (1 cm^2) to form the electrode layer by drying at 120 °C for around two hours. Typical weight of the active materials of each sample was controlled within 1.0 ± 0.2 mg cm^{-2}. The reference electrode and counter electrode were Ag/AgCl electrode and platinum foil, respectively.

Part II: Supplementary Figures

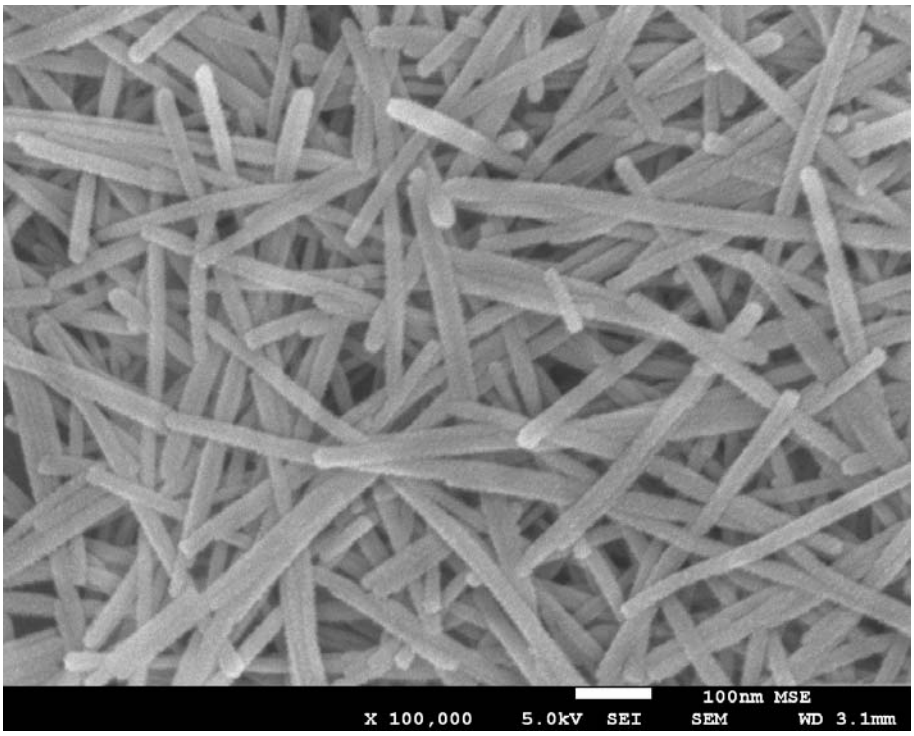

Figure S1 SEM image of the as-obtained $Ni(OH)_2$ nanowires.

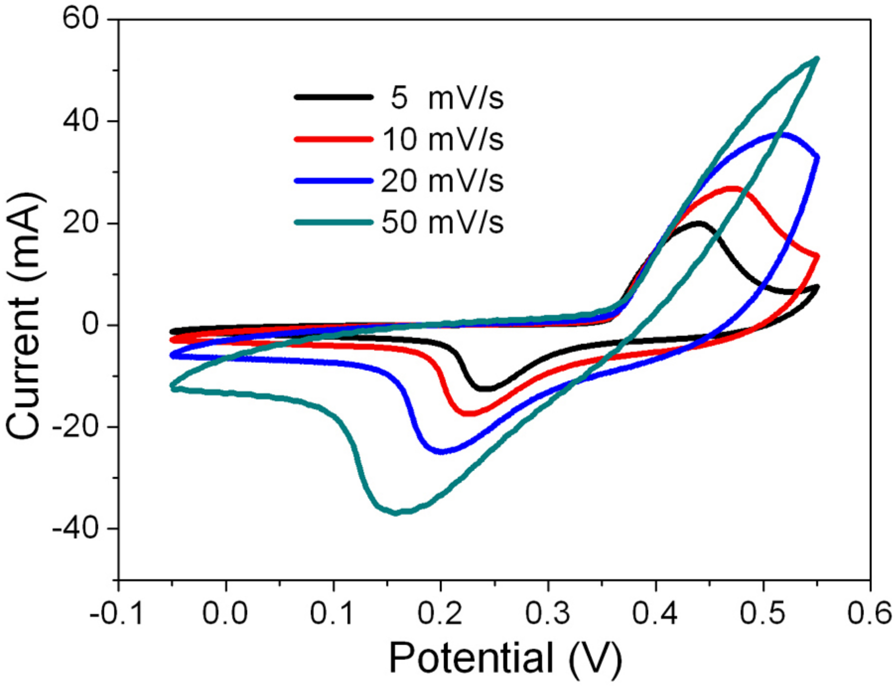

Figure S2 (a) CV curves at different scan rates of the Ni@MPC.

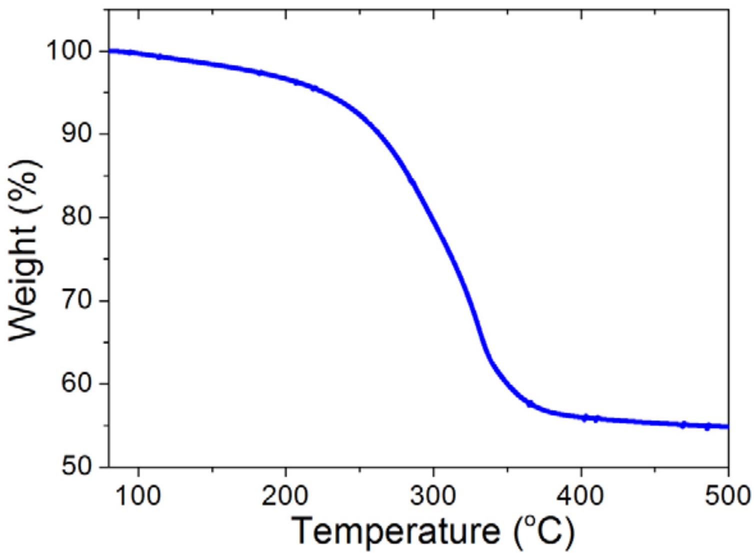

Figure S3 (a) TG curve of the Ni@MPC. According to the TG curves, the weight loss is ~46%. Therefore, it can be calculated that the carbon concentration of Ni@MPC is about 57.4% if metal Ni nanoparticles are oxidized into NiO completely.

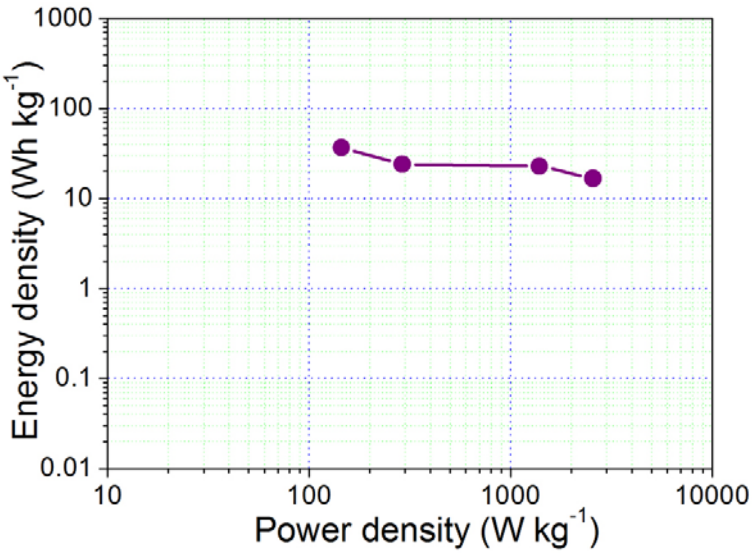

Figure S4 Ragone plot of the Ni@MPC. To evaluate the power applications of supercapacitors, the energy density and power density of the Ni@MPC nanocomposites electrode have been calculated according to the discharge curves at different current densities. The energy densities decreases from 36.8 to 16.7 Wh kg^{-1}, while the specific power densities increases from 145 to 2569 W kg^{-1}.

Part III: Calculations

The specific capacitance was calculated from the CV curves according to the following equation:

$$C = Q/(m\Delta V),$$

where C (F g^{-1}) is the specific capacitance, m(g) is the mass of the active materials, Q(C) is the average charge during the charging and discharging process, and ΔV(V) is the potential window.

The discharge specific capacitance could also be calculated from the discharge curves by the following equation:

$$C = I\Delta t/(m\Delta V),$$

where I(A), Δt(s), m(g) and ΔV(V) are the discharge current, discharge time consumed in the potential range of ΔV, mass of the active materials (or mass of the total electrode materials), and the potential windows, respectively.