Electronic Supplementary Material (ESI) for Materials Chemistry Frontiers.

Supporting Information

Boosting the electrochemical performance of carbon cloth negative electrodes by constructing 3D hierarchically porous nitrogen-doped carbon nanofiber layers for flexible all-solid-state asymmetric supercapacitors

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Assembling an asymmetric supercapacitor can effectively increase the potential window, resulting in an enhanced energy density. Based on the charge balance of positive and negative electrodes, NiO@CNFs/CC was synthesized as the positive electrode through combined chemical bath deposition and calcination process. The crystalline structure of of NiO@CNFs/CC was confirmed by the XRD (Fig. S1). Fig. S2a shows the SEM image of NiO@CNFs/CC with an ordered woven structure, which is similar to CC and NCNFs/CC. Fig. S2b, S2c clearly displays that the 3D porous structure of CNFs layers was not blocked by NiO layer coating. The porous NiO layers, composed of numerous thin nanosheets, provide large surface area for the faradic reactions, leading to high electrochemical performance (Fig. S2d).

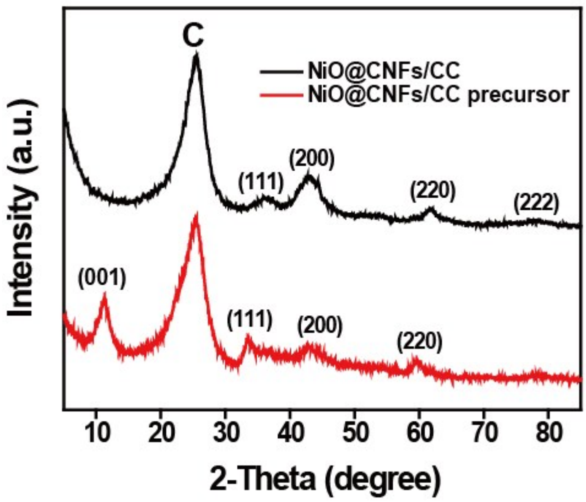

Fig. S1 XRD patterns of NiO/CNFs/CC and its precursor.

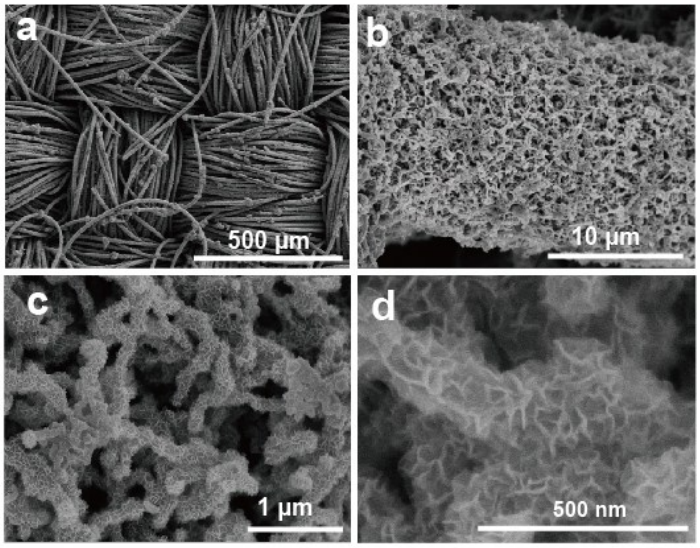

Fig. S2 (a-d) SEM images NiO/CNFs/CC.

The electrochemical performance of NiO@CNFs/CC was evaluated in 2 mol/L KOH solution. Fig. S3a shows the CV curves of NiO@CNFs/CC at various scan rates. A pair of redox peaks was observed in the CV curves due to the following reaction [1-4] :

$$NiO + zOH^{-} \leftrightarrow zNiOOH + (1\text{-}z)NiO + ze^{-}$$

where z (z=0-1) is the fraction of nickel sites involved in the electrochemical process. The value of z reflects the material utilization of the electrode active material [4]. As shown in Fig. S3b, the symmetric GCD curve shapes and nonlinear discharge curves indicate an excellent pseudocapacitive performance. The specific capacitances decreased with increasing the current density (Fig. S3c). The largest areal capacitance was 1045 mF/cm^2 at a current density of 2 mA/cm^2. The cycling stability characterization was performed at a current density of 30 mA/cm^2 (Fig. S3d). The capacitance retention slightly decreased to 80 % after the 3000th cycle, indicating good long-term stability.

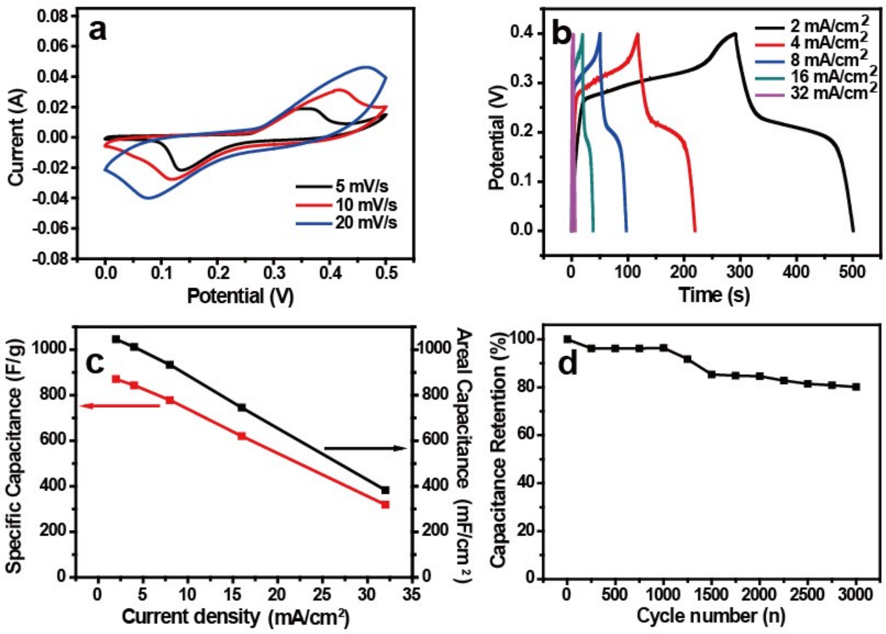

Fig. S3 (a) CV and (b) GCD curves of NiO@CNFs/CC at different scan rates and current densities. (c) Specific capacitances and areal capacitances of NiO@CNFs/CC at various densities. (d) Cycling stability of NiO@CNFs/CC.

Reference

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