Supporting Information

Highly thermal conductive graphene-based electrodes for supercapacitors with excellent heat dissipation ability

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1. Preparation of MnO$_2$ nanoparticles and morphology characterizations

The MnO$_2$ nanoparticles were prepared by redox reaction of KMnO$_4$ and MnSO$_4$ as chemical equation (S1)

$$\text{MnO}_4^- + \text{Mn}^{2+} \rightarrow 2\text{MnO}_2 \quad (S1)$$

The MnO$_2$ nanoparticles have good dispersion and uniform size as shown in Fig. S1.

Fig. S1. SEM images of MnO$_2$ nanoparticles at different magnifications.
2. The preparation of GN-MnO$_2$ film

To achieve a favorable electrostatic assembly between the MnO$_2$ nanoparticles and GO nanosheets, MnO$_2$ nanoparticles were firstly modified by aminopropyltrimethoxysilane (APS) to render the nanoparticles surface positively. In contrast, the zeta potential of GO solution is negative. Therefore, assembly between the modified MnO$_2$ nanoparticles and GO nanosheets via electrostatic interactions was easily triggered to form the MnO$_2$@GO nanostructure. The MnO$_2$@GO solution through vacuum filtration to assemble the MnO$_2$@GO film, after peeling off from the filter paper, the MnO$_2$@GO film was hot pressed which made it more flatter and assembly the layer to layer more compact. The thickness of the films could be well controlled from several to several ten micrometers by adjusting the volume and concentration of MnO$_2$@GO suspension. Thermal annealing at 900 °C in Ar was further employed for the reduction of the MnO$_2$@GO film. Finally, a free-standing and paper-like GN-MnO$_2$ film was obtained. The digital photographs of the experimental setup and GN-MnO$_2$ films were illustrated in Fig. S2.

![Fig. S2. (a) The setup of vacuum filtration for GO-MnO$_2$ solution, (b) Digital photos of GN-MnO$_2$ film.](image-url)
Fig. S3. Different magnifications of GN film (a, b) surface morphology, (c, d) cross section morphology.
Fig. S4 The EDS mapping of Mn element and the corresponding map sum spectrum for the GN-MnO₂ film (a, b) the surface, (c, d) the bottom side.