Electronic Supplementary Information (ESI)

Enhanced capacitive deionization performance of graphene/carbon nanotube composites

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Additional Results and Discussion

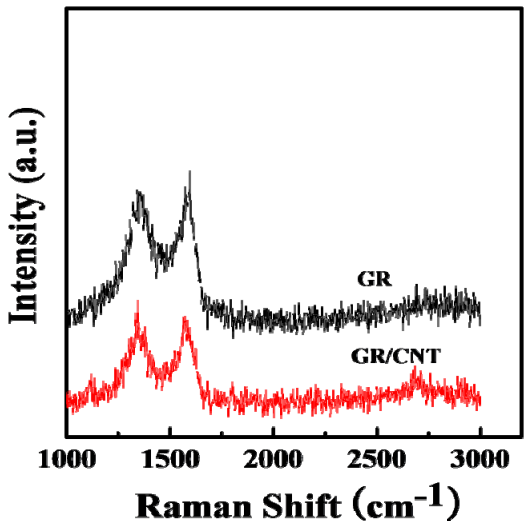

Fig. S1 Raman spectra of GR and GR/CNT composites.

The Raman scattering is strongly sensitive to the electronic structure and proves to be an essential tool to characterize the GR materials. In many cases, the Raman spectrum of the GR is characterized by two main features, the G band is a characteristic feature of graphitic carbon layers corresponding to the tangential vibration of the carbon atoms, whereas the D band is a typical sign of the presence of defective graphitic carbon[1]. The Raman spectrum of GR and GR/CNT composites presents a defect peak (D band) at 1340 cm^{-1} and a G peak at 16103 cm^{-1} and 2D band at 2685 cm^{-1}. It has also been reported that there is a correlation between the ratio I_G/I_{2D} and the number of layers in GR[2]. The peak of 2D band of the GR/CNT composites suggests that the GR in GR/CNT composites is few-layered[3], which is consistent with the XRD results.

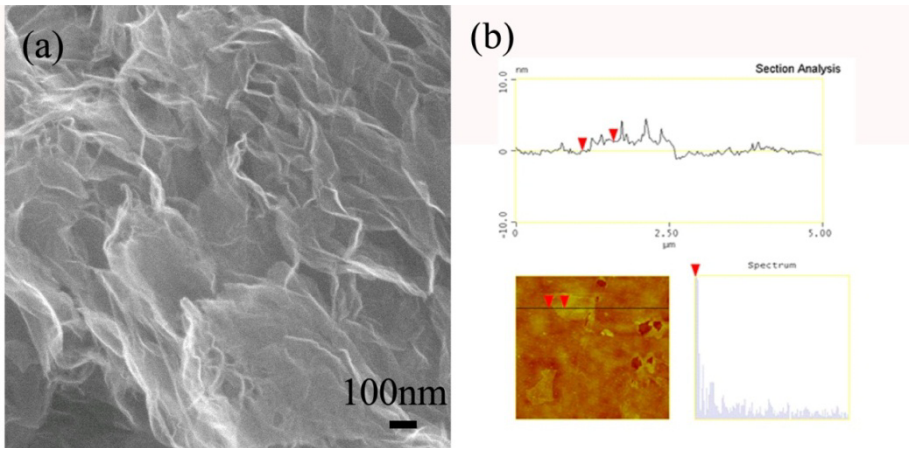

Fig. S2 (a) SEM and (b) AFM images of GR with a corresponding line profile.

The GR shows a porous and layered structure with a smooth surface and sheet-like form. It reveals that the most of the GO are efficiently exfoliated and ultrathin sheets are obtained[4]. The AFM analysis indicates that the thickness of the GR is approximately 1.2 nm as shown in Fig. S2b, indicating two or three layers[5].

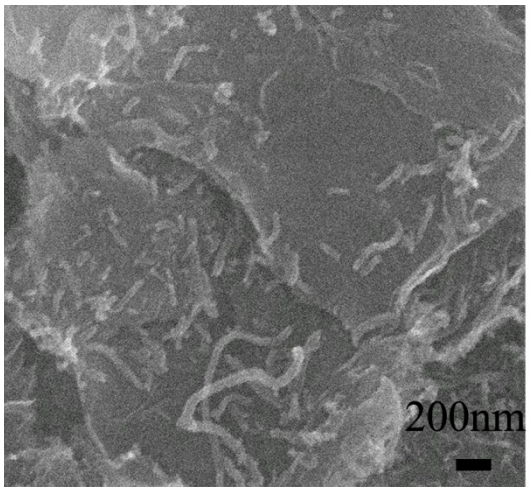

Fig. S3 SEM image of GR/CNT-20%.

The GR/CNT-20% composites (Fig. S3) show that several over-stacked CNTs covers on the GR surface due to that the excess CNTs favorable for the formation of aggregates through the π-stacking interaction of the CNTs, indicating the excessive amount of CNTs is not favorable for the exfoliation of GR.

The reversibility of the GR and GR/CNT electrodes for electrosorption process was measured by a galvanostatic charge/discharge method in a 0.5 M NaCl aqueous solution at various current loads (Fig. S4). It can be seen that all the curves of the GR and GR/CNT electrodes are well-retained

triangular shape, which reflects the good reversibility and the demonstrated electrosorption behavior resulting from electrostatic attraction not Faradaic reaction[5, 6]. As observed, the IR drop of GR electrodes is evident at the high current density, indicating the relatively poor rate capability of GR electrode. For GR/CNT electrodes, with a low current density the voltage response is closer to an ideal linear charge/voltage relationship, indicating a lower iR drop (potential drop) is obtained. The iR drop (ohmic drop) of GR/CNT composite electrodes can be negligible which indicates that the electrodes have a low internal resistance.

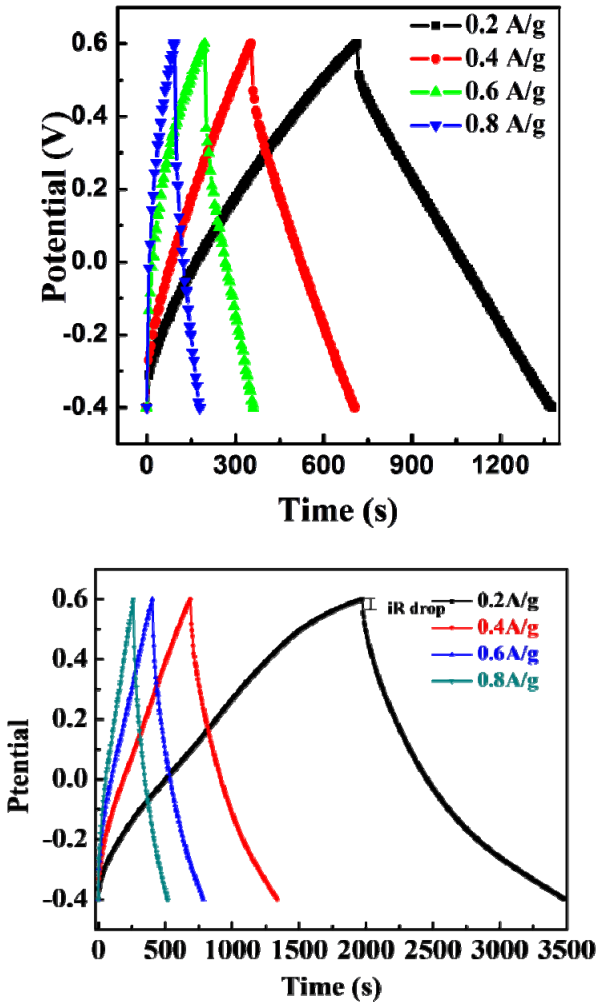

Fig. S4 Galvanostatic charge/discharge curves of the GR (top) and GR/CNT (bottom) electrode at various current loads in a 0.5 M NaCl aqueous solution.

References:

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