Supporting information

Ultrahigh Performance of Novel Electrochemical Deionization System based on $NaTi_2(PO_4)_3$/rGO Nanocomposite

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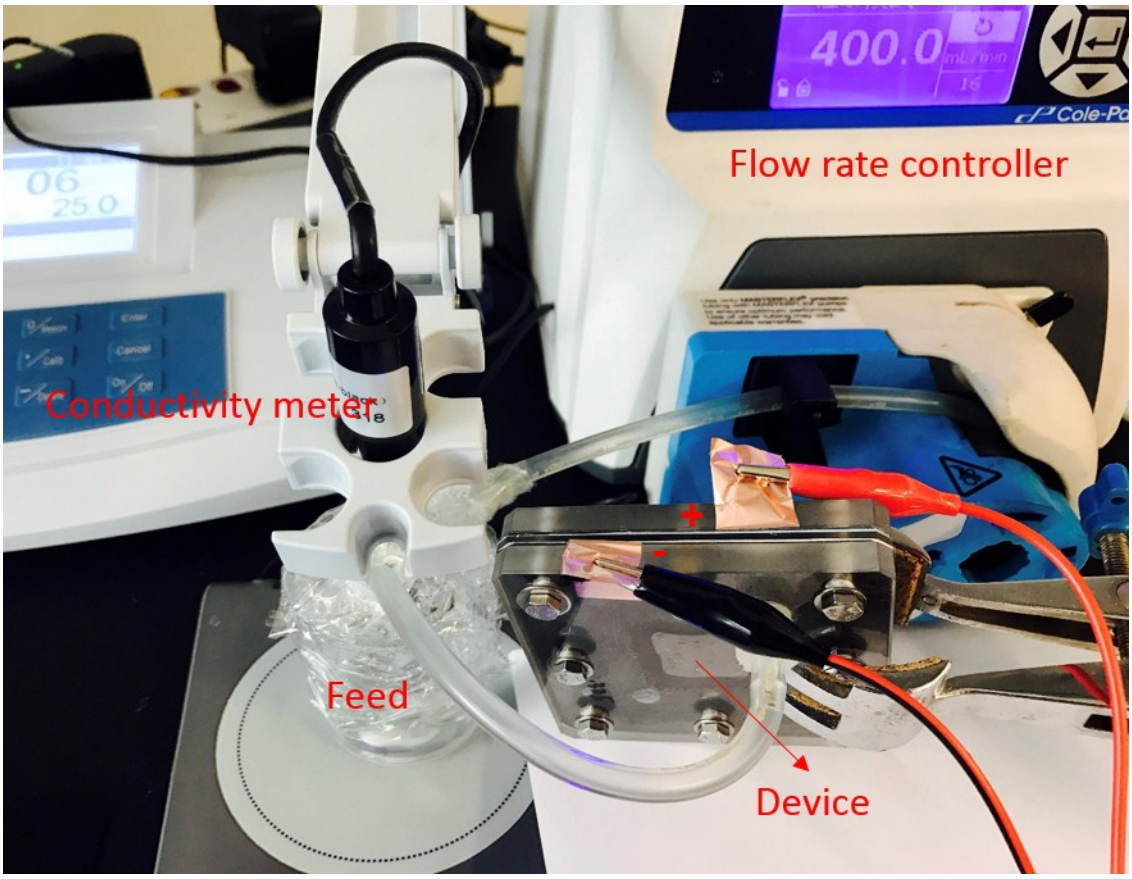

Fig. S1. Photo of the experimental setting up of EDI system. The EDI device works in a flow through system, where 50 ml NaCl solution is used as feed. The feed water is circled back through the EDI

device by the pump with controlled flow rate, while the conductivity of the feed solution is continuously monitored and recorded by a conductivity meter. A constant current is applied through the EDI device by an electrochemical workstation.

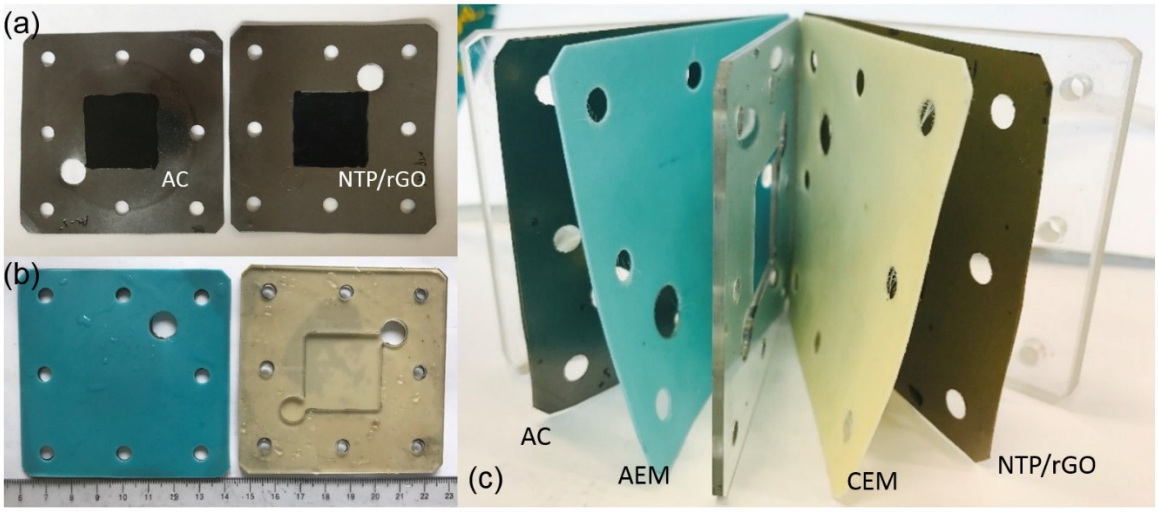

Fig. S2. (a) The working electrodes of AC and NTP/rGO; (b) the half electrodes of AC with anion exchange membrane and NTP/rGO with cation exchange membrane; (c) EDI device. From left to right: AC electrode, anion exchange membrane, separator, cation exchange membrane, NTP/rGO electrode.

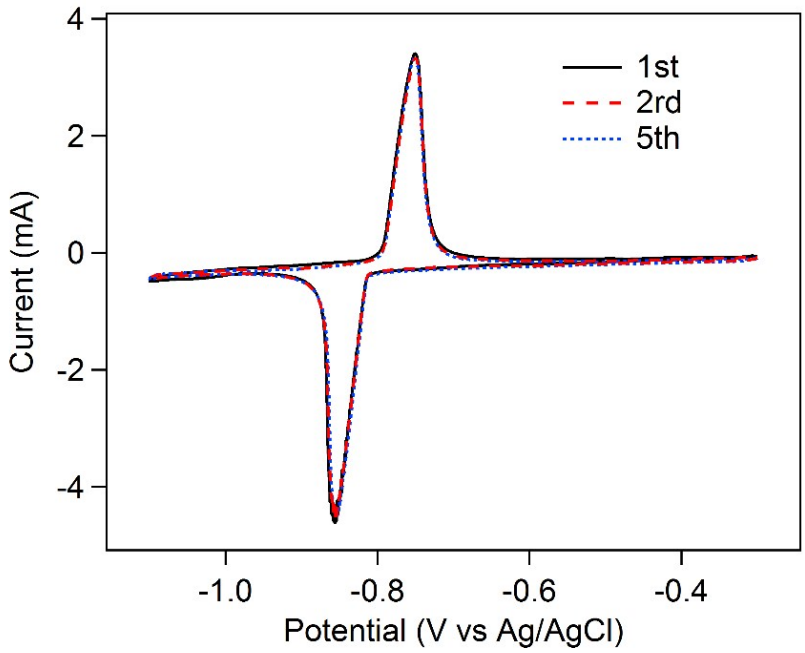

Fig. S3. Three-electrode cyclic voltammetry (CV) curves of NTP/rGO with Pt as counter and Ag/AgCl as reference electrode in 1 M NaCl electrolyte. Scan rate: 0.2 mV s^{-1}

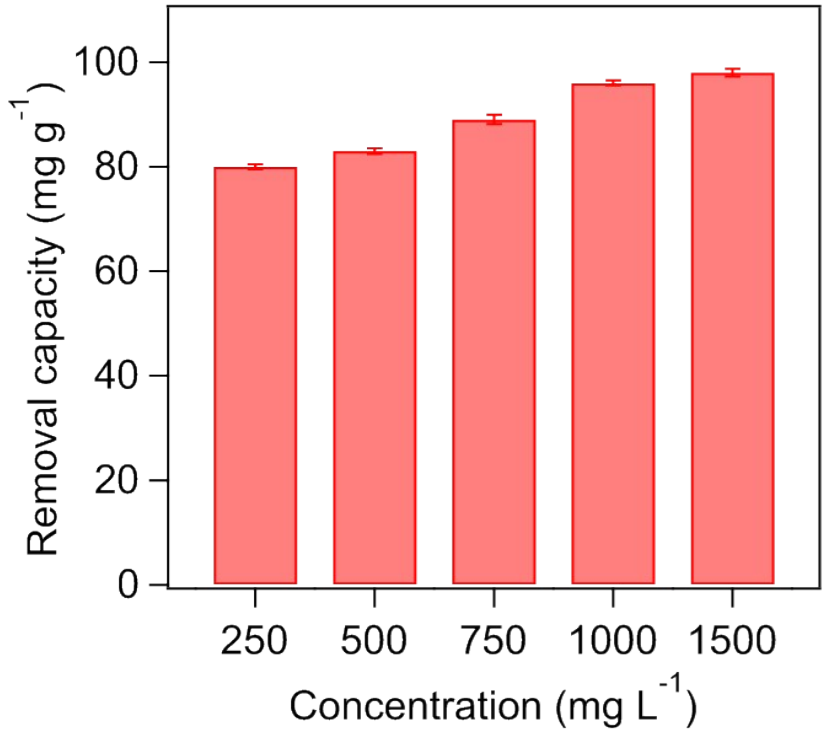

Fig. S4. The removal capacity of NTP/rGO at different feed concentration. The flow rate of the feed is 400 mL min^{-1}, while the initial concentration of 50 mL feed solution varies from 250 to 1500 mg L^{-1}, the mass of active materials is ~ 10 mg for both NTP/rGO and AC electrode, and the applied current density is 150 mA g^{-1}.

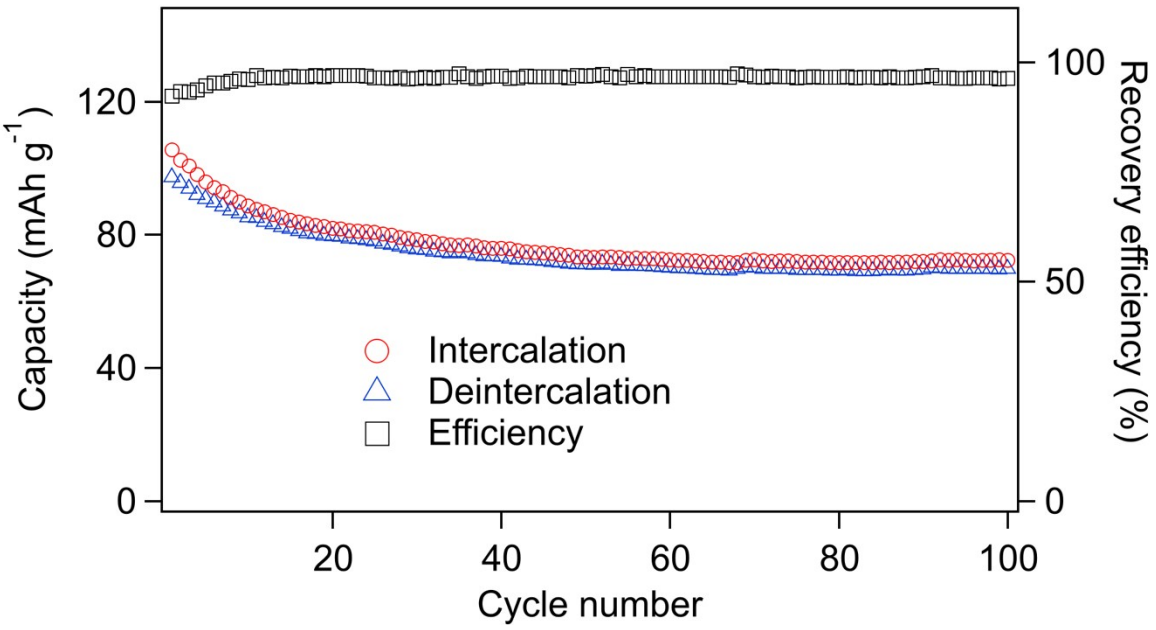

Fig. S5. The electric charge capacity of EDI system over 100 cycles based on NTP/rGO during intercalation and deintercalation at current density of 100 mA g^{-1}.

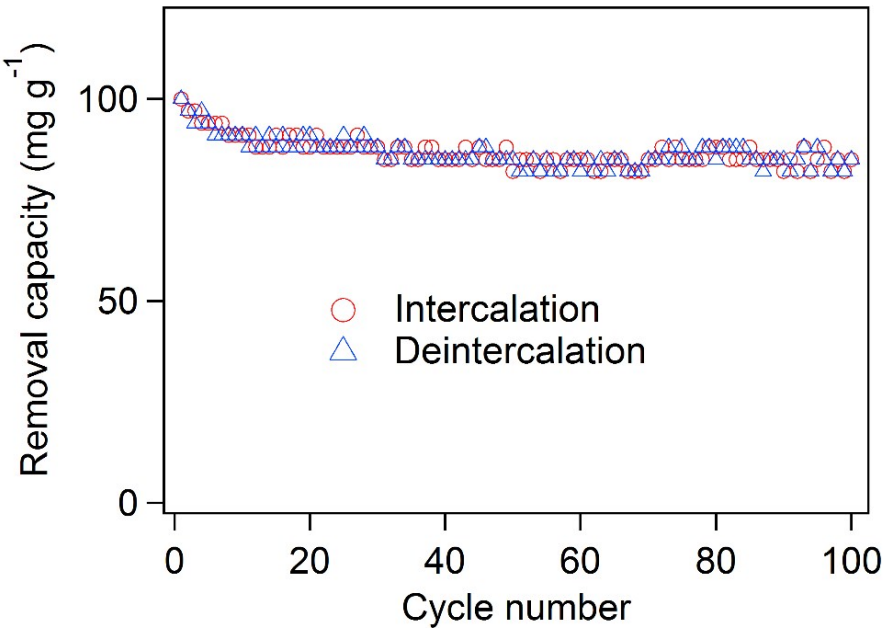

Fig. S6. Removal capacity of the NTP/rGO and NTP electrodes during cycling experiments with current density of 150 mA g^{-1}.

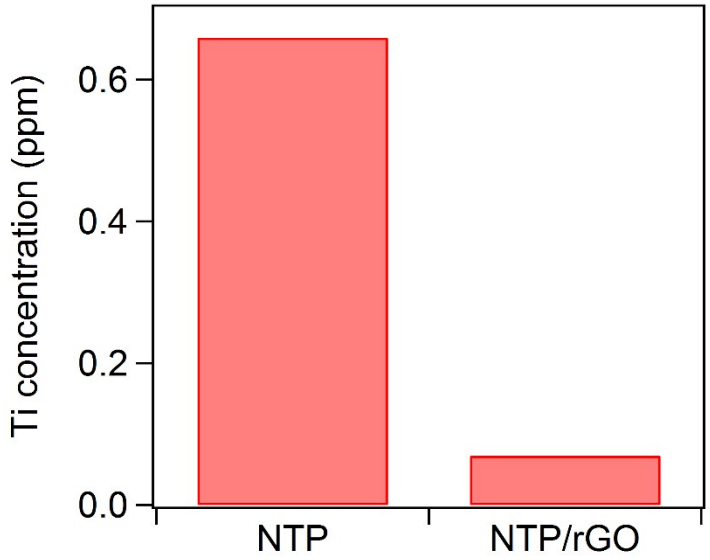

Fig. S7. The concentration of titanium in feed solution of NTP and NTP/rGO electrodes after 100 cycles at 100 mA g^{-1}.

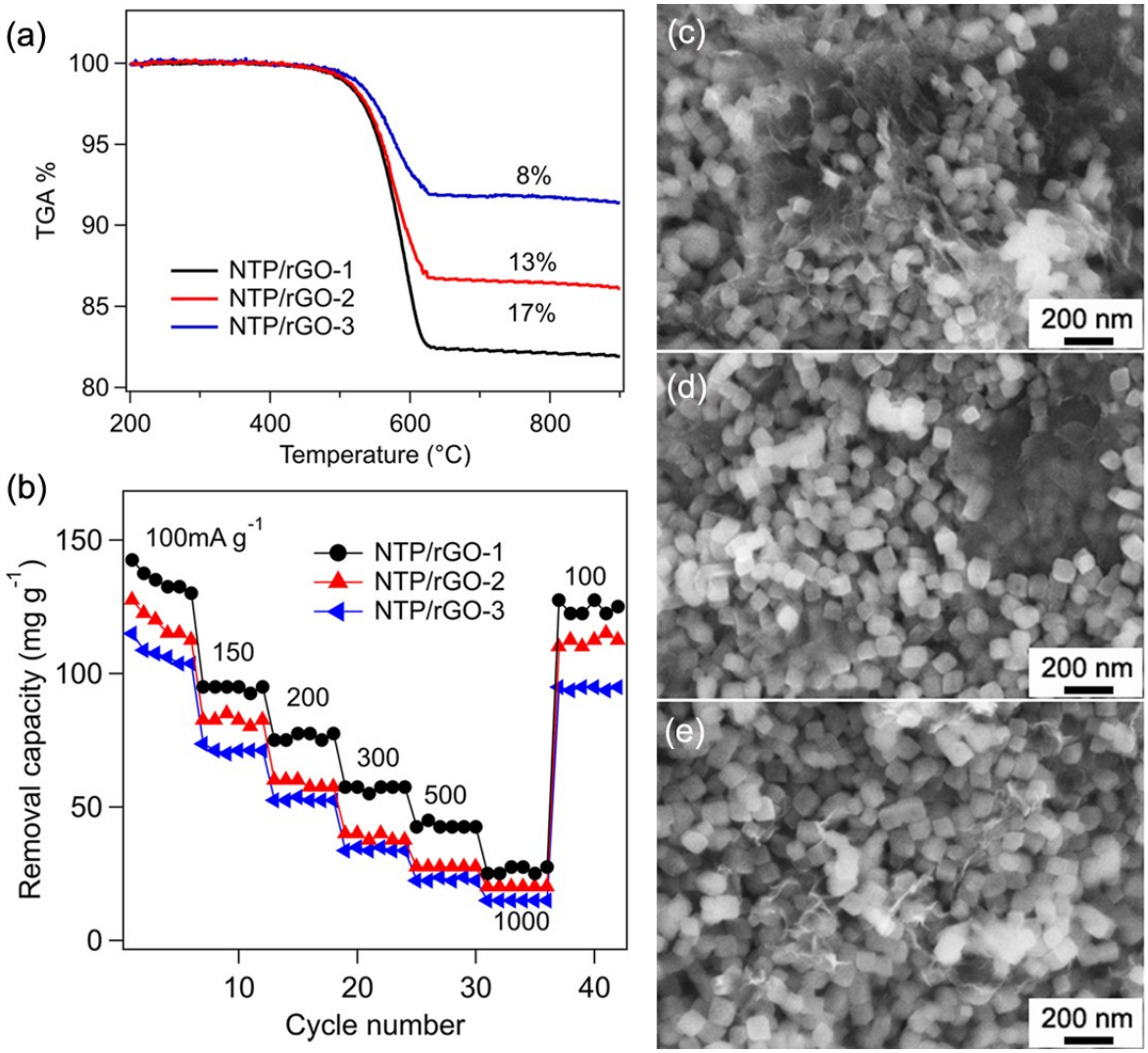

Fig. S8. (a) TGA profile of NTP/rGO with different ratio of graphene measured at a heating rate of 5 °C min^{-1} in air. (b) Rate performance and removal capacity retention ability of NTP/rGO electrodes containing different ratio of graphene; (c-e) SEM images of NTP/rGO with 8%, 13% and 17% graphene.

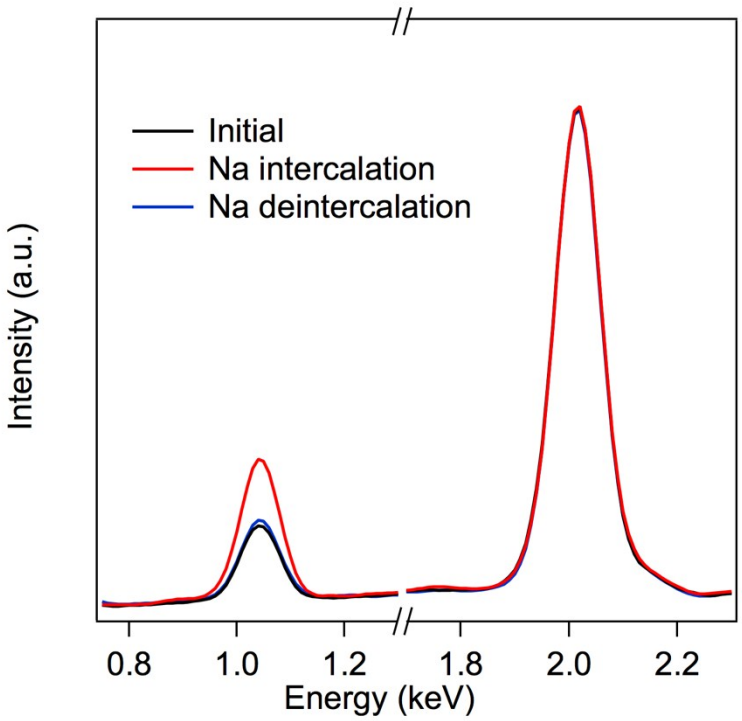

Fig. S9. EDS spectra of NTP/rGO. A detailed comparison of EDS spectra of initial state, intercalation state of sodium, and deintercalation state of sodium.

Table S1. The element composition of Na, Ti, P, and O in the as-prepared NTP/rGO, sodium intercalation state and sodium deintercalation state, and the calculated weight ratio of Na:P.

Wt %	***Na***	***Ti***	***P***	***O***	***Na : P***
Initial NTP/rGO	5.4	24.1	22.1	48.2	0.249
Na intercalation	9.7	21.3	20.5	48.5	0.473
Na deintercalation	5.7	23.2	21.6	49.5	0.264