ACS APPLIED MATERIALS & INTERFACES

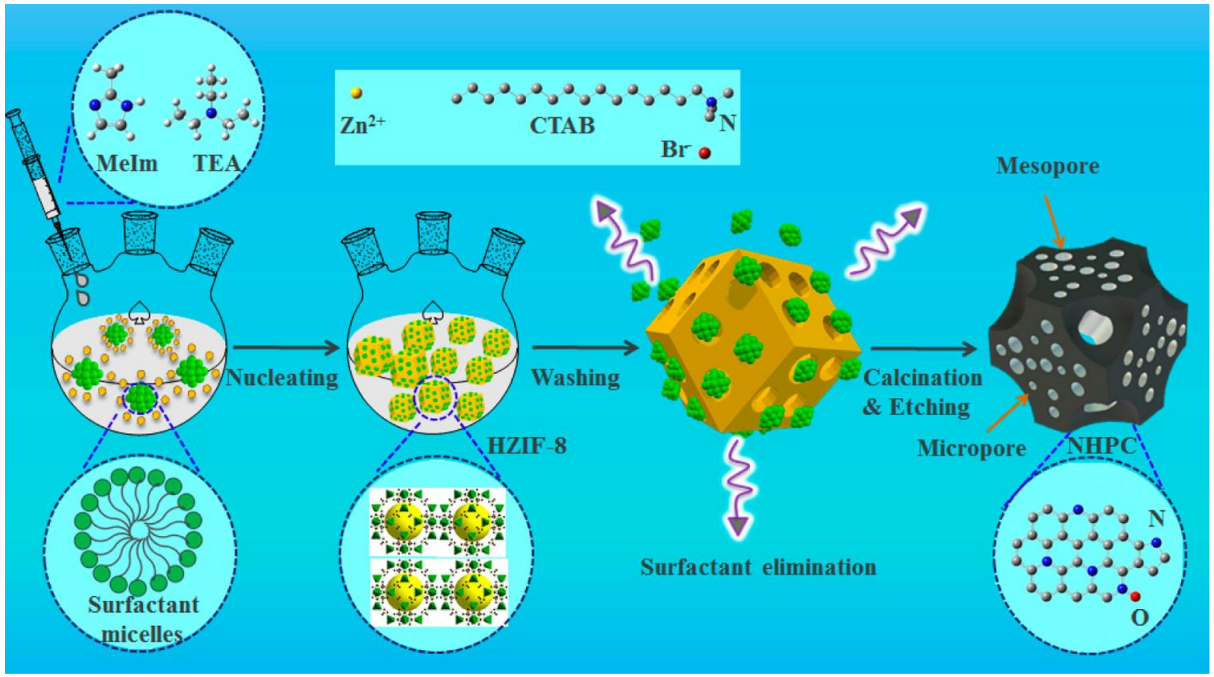
Research Article

www.acsami.org

In Situ Expanding Pores of Dodecahedron-like Carbon Frameworks Derived from MOFs for Enhanced Capacitive Deionization

Zhuo Wang, Tingting Yan, Liyi Shi, and Dengsong Zhang*

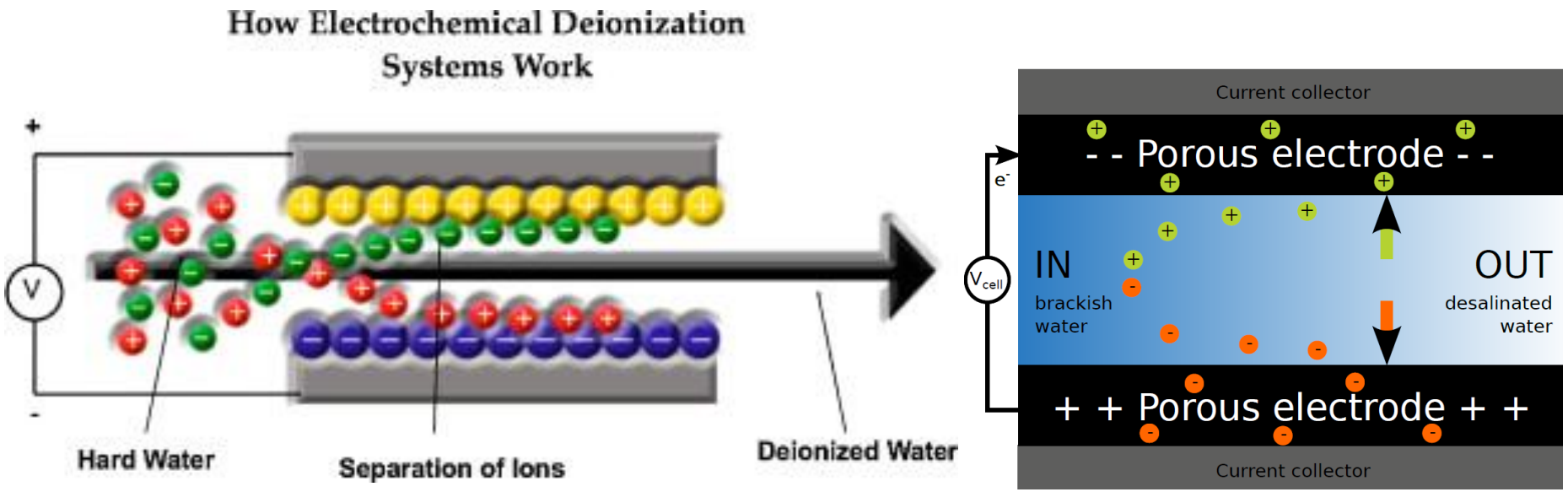
Department of Chemistry, Research Center of Nano Science and Technology, Shanghai University, Shanghai 200444, P. R. China



DOI: 10.1021/acsami.7b02712
ACS Appl. Mater. Interfaces 2017, 9, 15068−15078

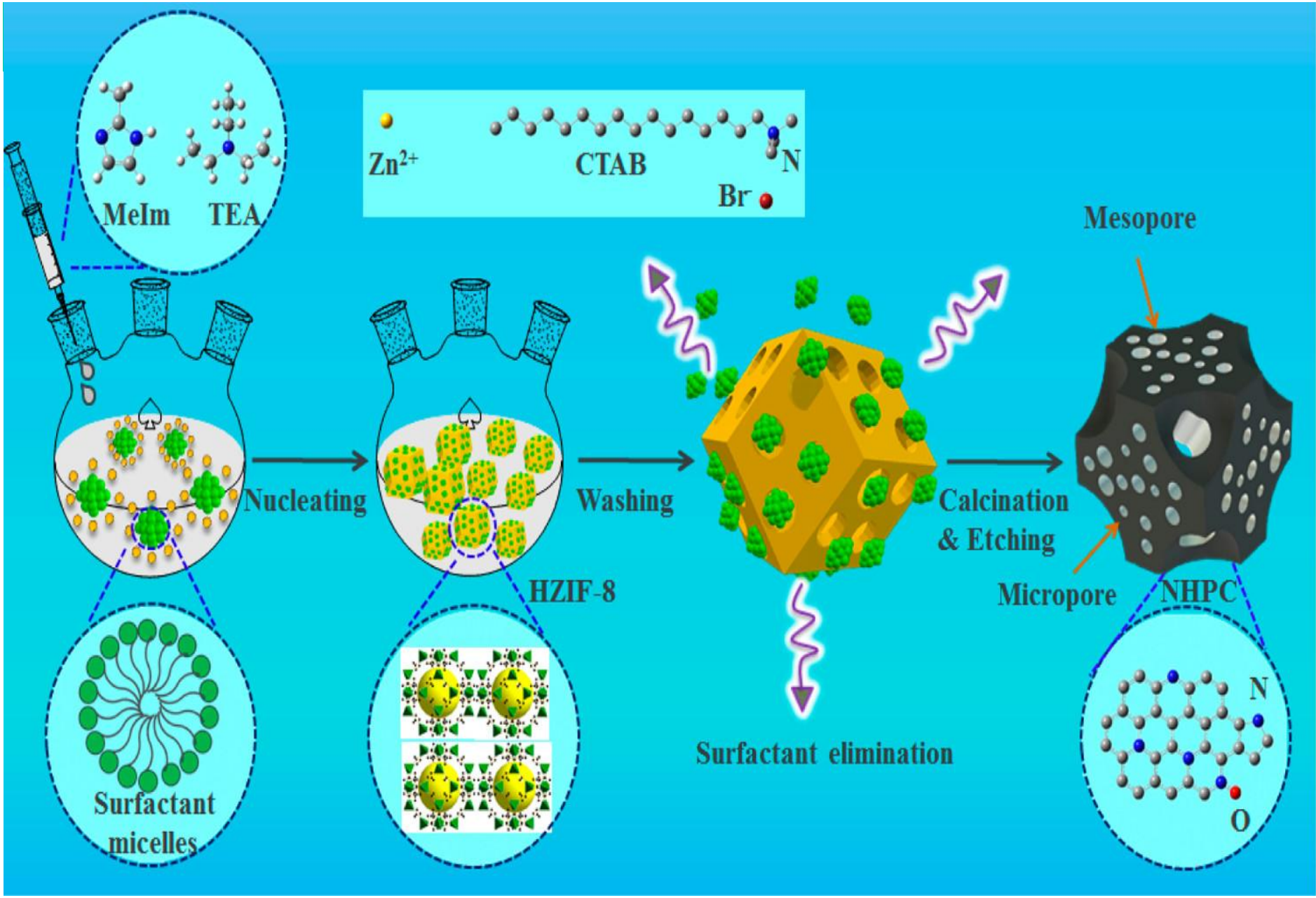
Md Rabiul Islam
13-05-2017

What is CDI?



- **Capacitive deionization (CDI)** is a technology to deionize water by applying an electrical potential difference over two porous carbon electrodes.
- Anions, ions with a negative charge, are removed from the water and are stored in the positively polarized electrode. Likewise, cations (positive charge) are stored in the cathode, which is the negatively polarized electrode.
- In CDI , ions are adsorbed onto the surface of porous electrodes by applying a low voltage electric field, producing deionized water. Liquid is flowing between the high surface area electrode pairs having a potential difference of 1.0-2.0 V DC.

Image courtesy: M.A. Anderson et al. / Electrochimica Acta *55 (2010) 3845–3856* and Wikipedia.


MeIm
TEA
Zn2+
CTAB
N
Br
Nucleating
Washing
Calcination
& Etching
Mesopore
Micropore
NHPC
HZIF-8
Surfactant elimination
Surfactant
micelles
N
O

Result and Discussion

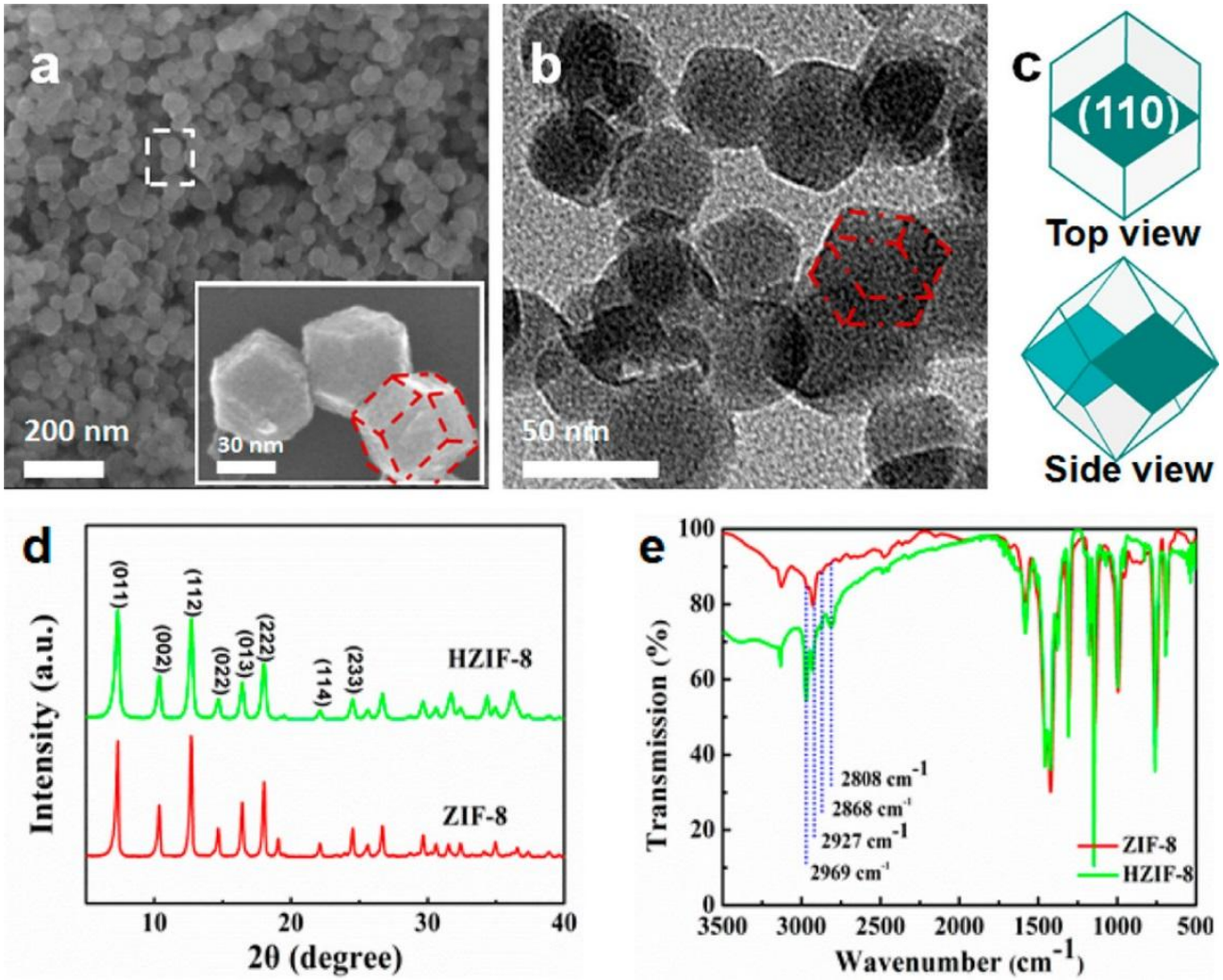


Fig 1. (a) SEM images and (b) TEM images of as-synthesized HZIF-8. (c) The corresponding a rhombic dodecahedron-like structural model in two orientations. (d) XRD patterns and (e) FT-IR spectra of the normal ZIF-8 and HZIF-8.

Result and Discussion

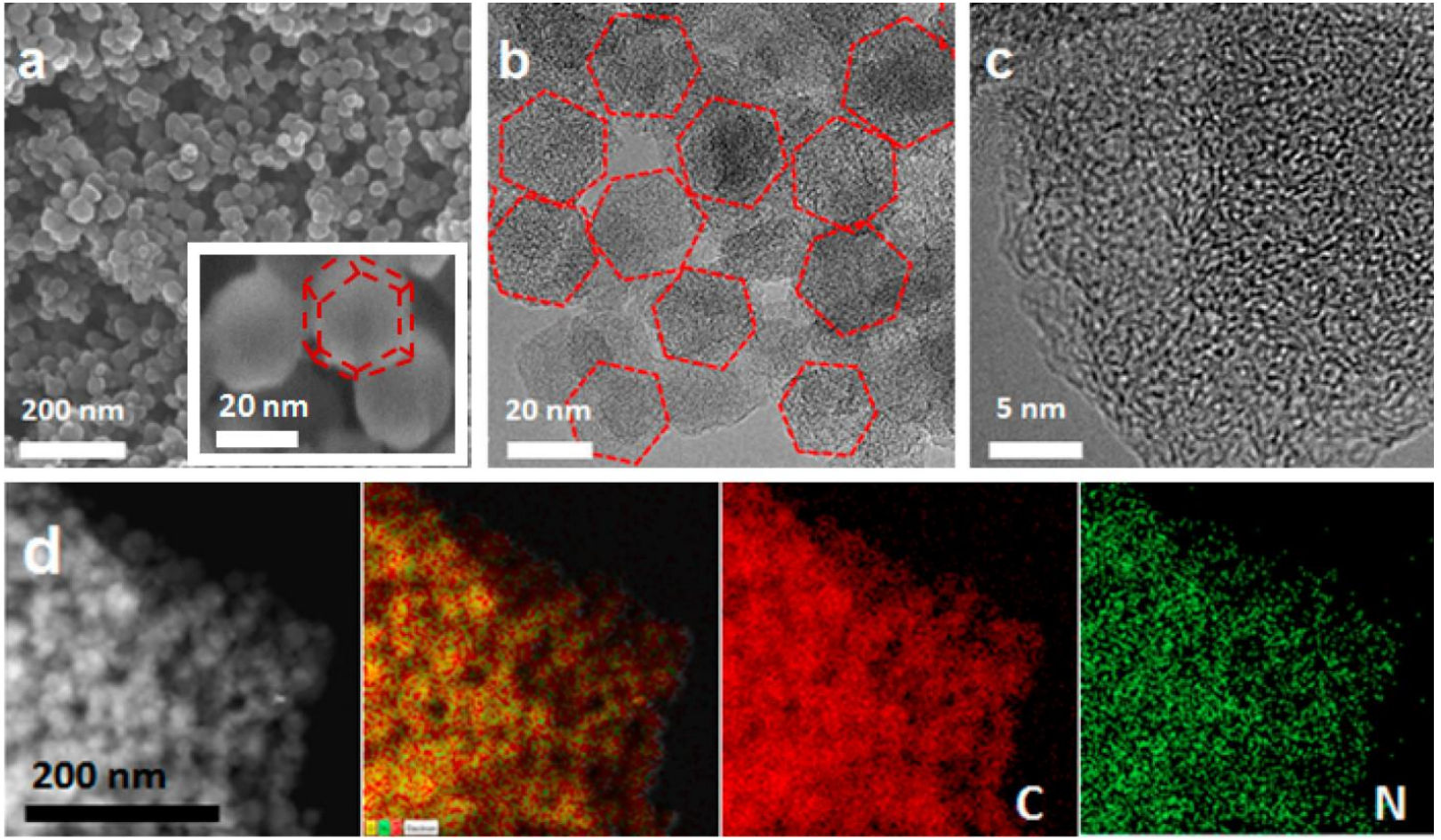


Fig 2. (a) SEM images, (b) TEM images, (c) HRTEM images, and (d) the corresponding elemental mappings of NHPC.

Result and Discussion

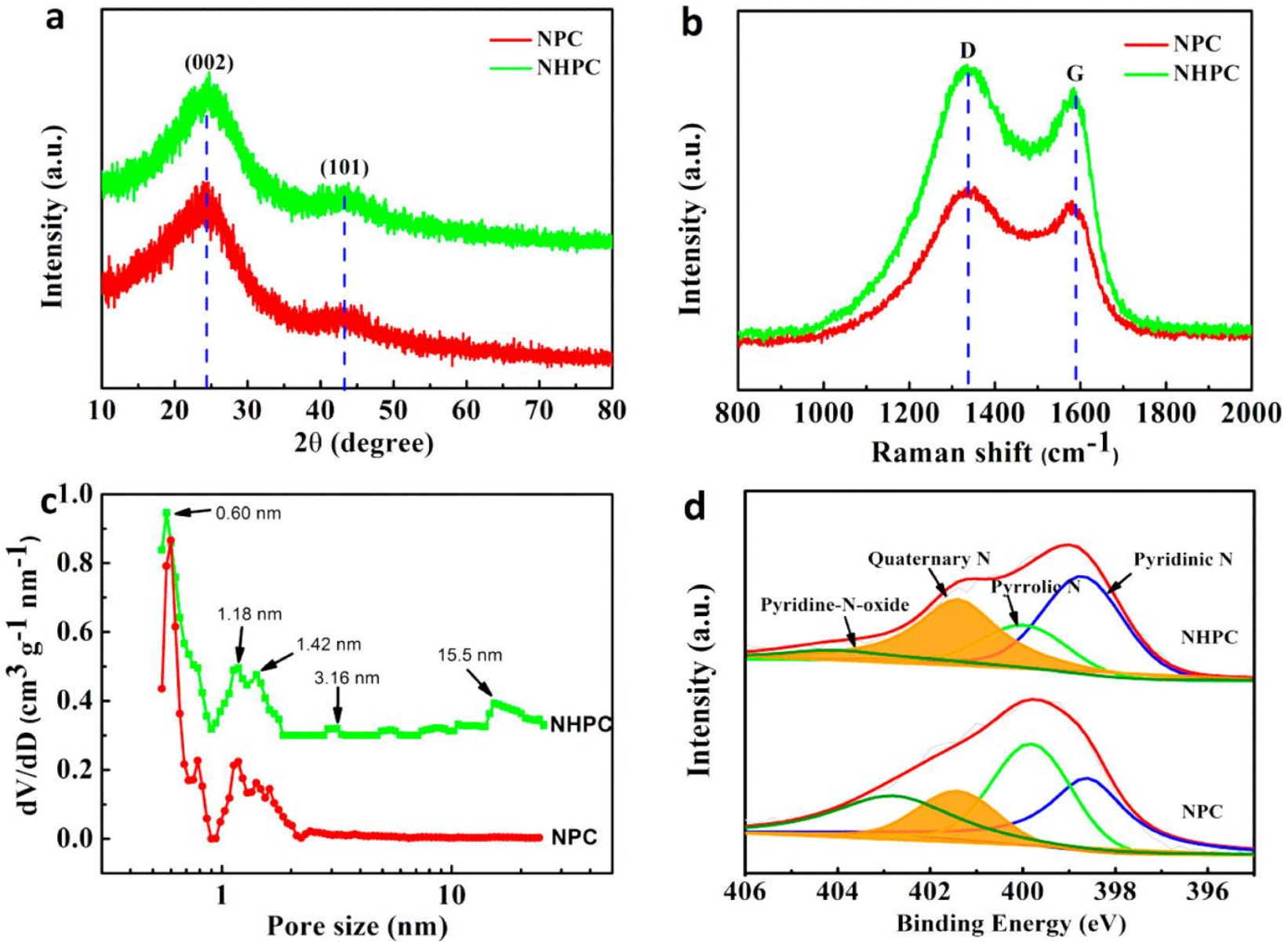


Fig 3. (a) XRD patterns, (b) Raman spectra, (c) pore-size distributions, and (d) high-resolution N 1s spectrum of samples. For clarity, d*V*/d*D* values of NHPC are offset by 0.3 cm3 g^{-1} nm^{-1}.

Result and Discussion

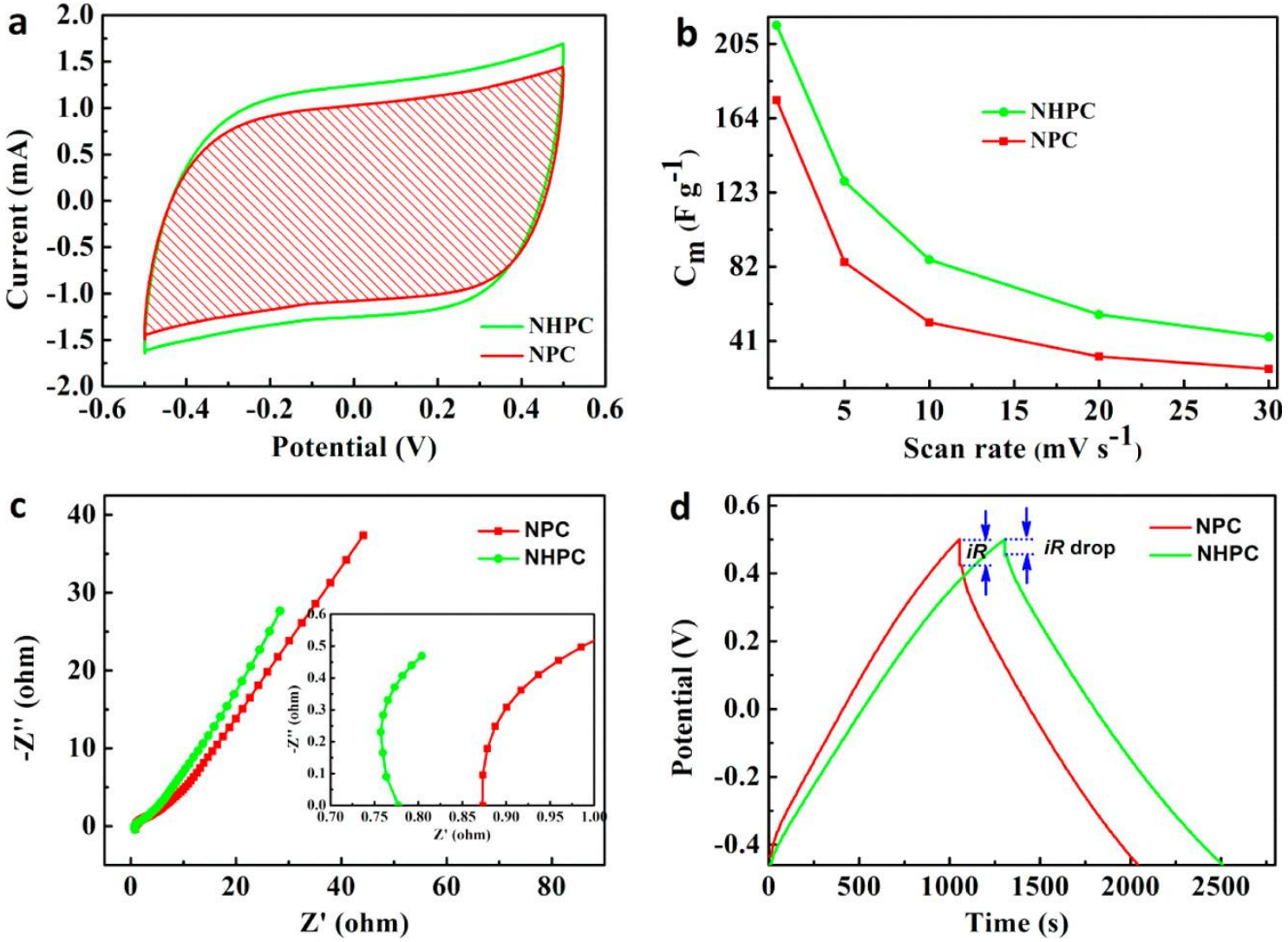


Fig 4. (a) Cyclic voltammograms at a potential sweet rate of 1 mV/s, (b) the specific capacitance of the electrodes at different sweet rates, (c) Nyquist electrochemical impedance spectra (the inset is the enlarged view of the high frequency region), and (d) galvanostatic charge/discharge curves of the NHPC and NPC electrodes at the current density of 200 mA/g. All the curves were obtained in a 0.5 M NaCl solution.

Result and Discussion

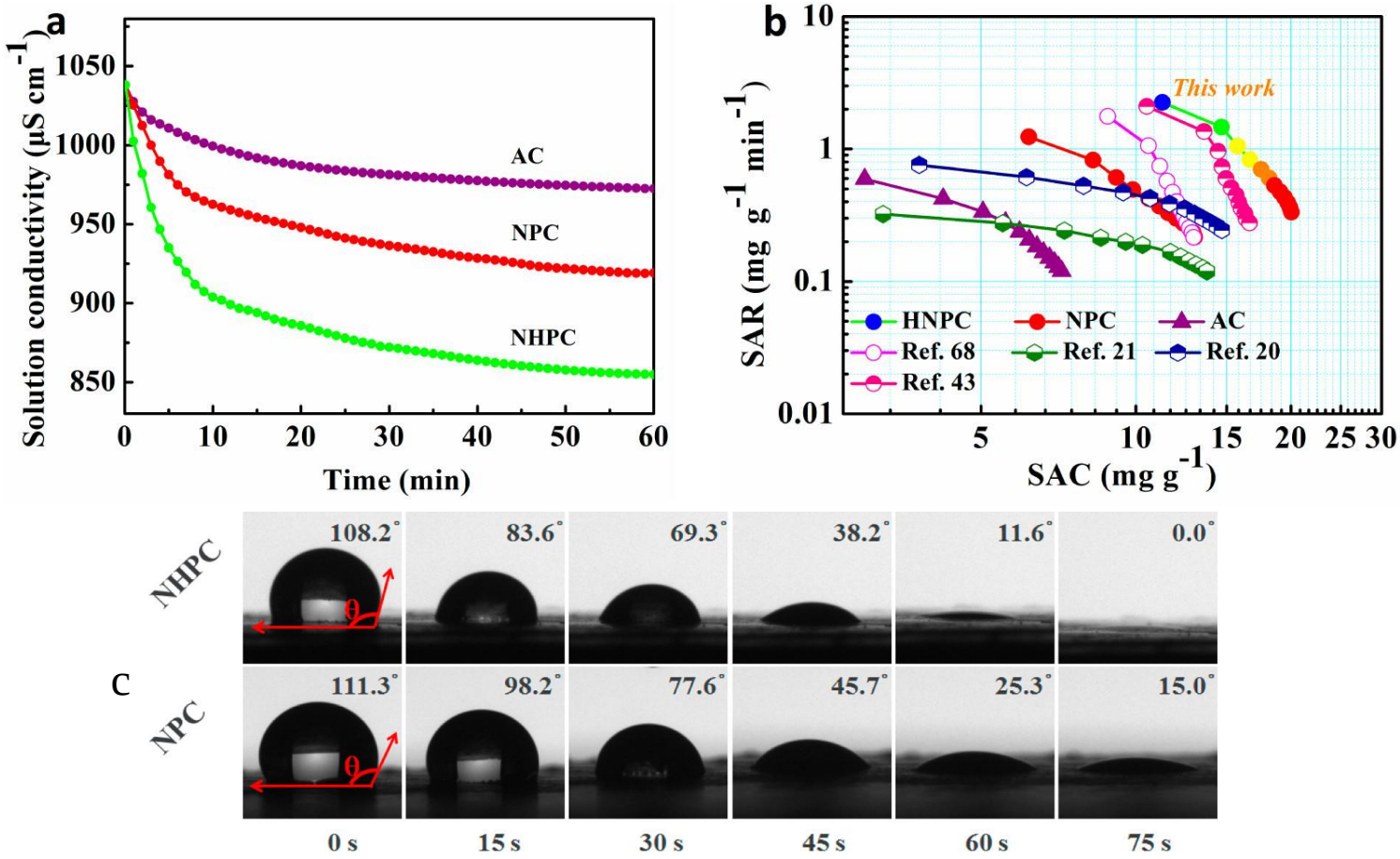


Fig 5. (a) Plots of solution conductivity vs deionization time in a 500 mg/L NaCl solution at a cell voltage of 1.4 V with a flow rate of 20 mL/min. (b) CDI Ragone plots of NHPC, NPC, and AC electrodes compared with the recently reported N-doped porous hollow carbon spheres,(68) 3D graphene electrode,(21) 3D hierarchically porous graphene,(20) and bimetallic ZIF derived nanoporous carbon.(43) (c) Optical micrographs of the water contact angles on the surface of NHPC and NPC electrodes as a function of contact time.

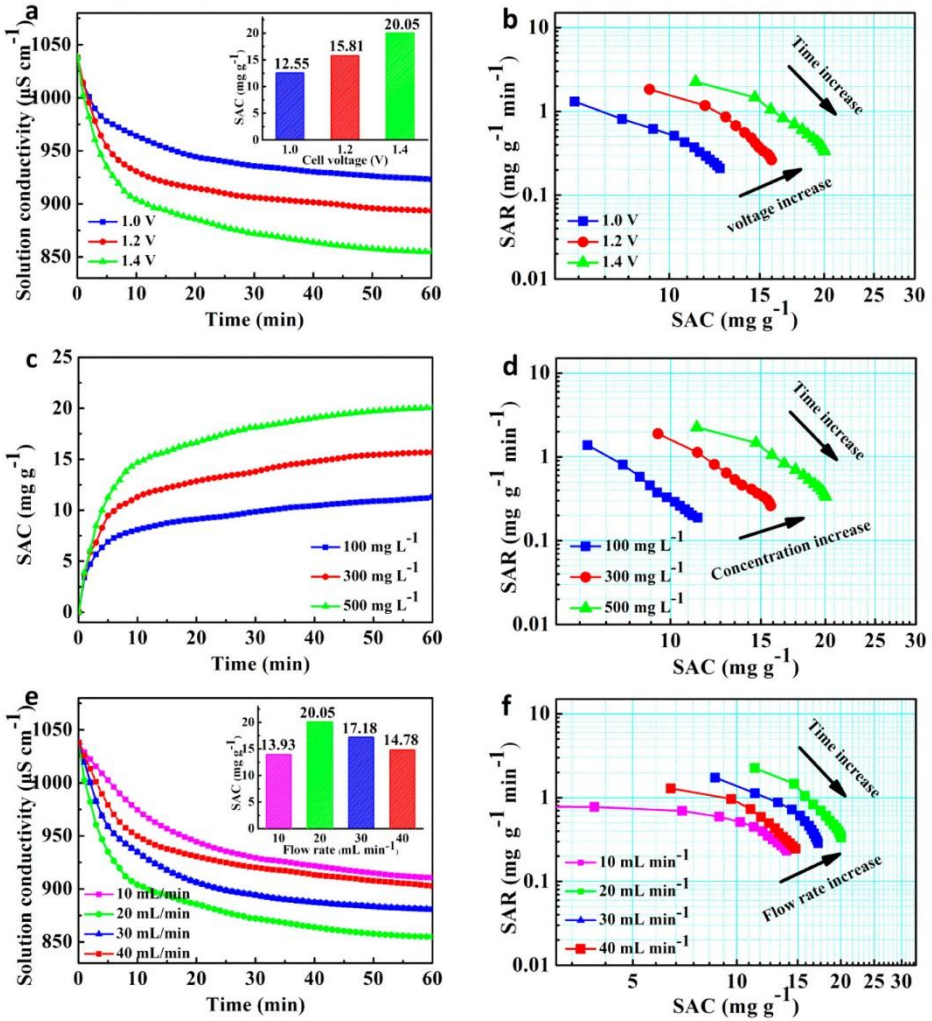


Fig 6. CDI performance of the NHPC electrode: (a) the variation of conductivity along with the desalination time (the inset shows the SAC at different applied voltages) and (b) CDI Ragone plots in a 500 mg/L NaCl solution at different cell voltages with a flow rate of 20 mL/min; (c) the SAC curves and (d) CDI Ragone plots in different concentrations of NaCl solution at a voltage of 1.4 V with a flow rate of 20 mL/min; (e) the conductivity variation with deionization time (the inset represents the SAC at different flow rates) and (f) CDI Ragone plots in a 500 mg/L NaCl solution with the cell voltage of 1.4 V at the different flow rates.

Result and Discussion

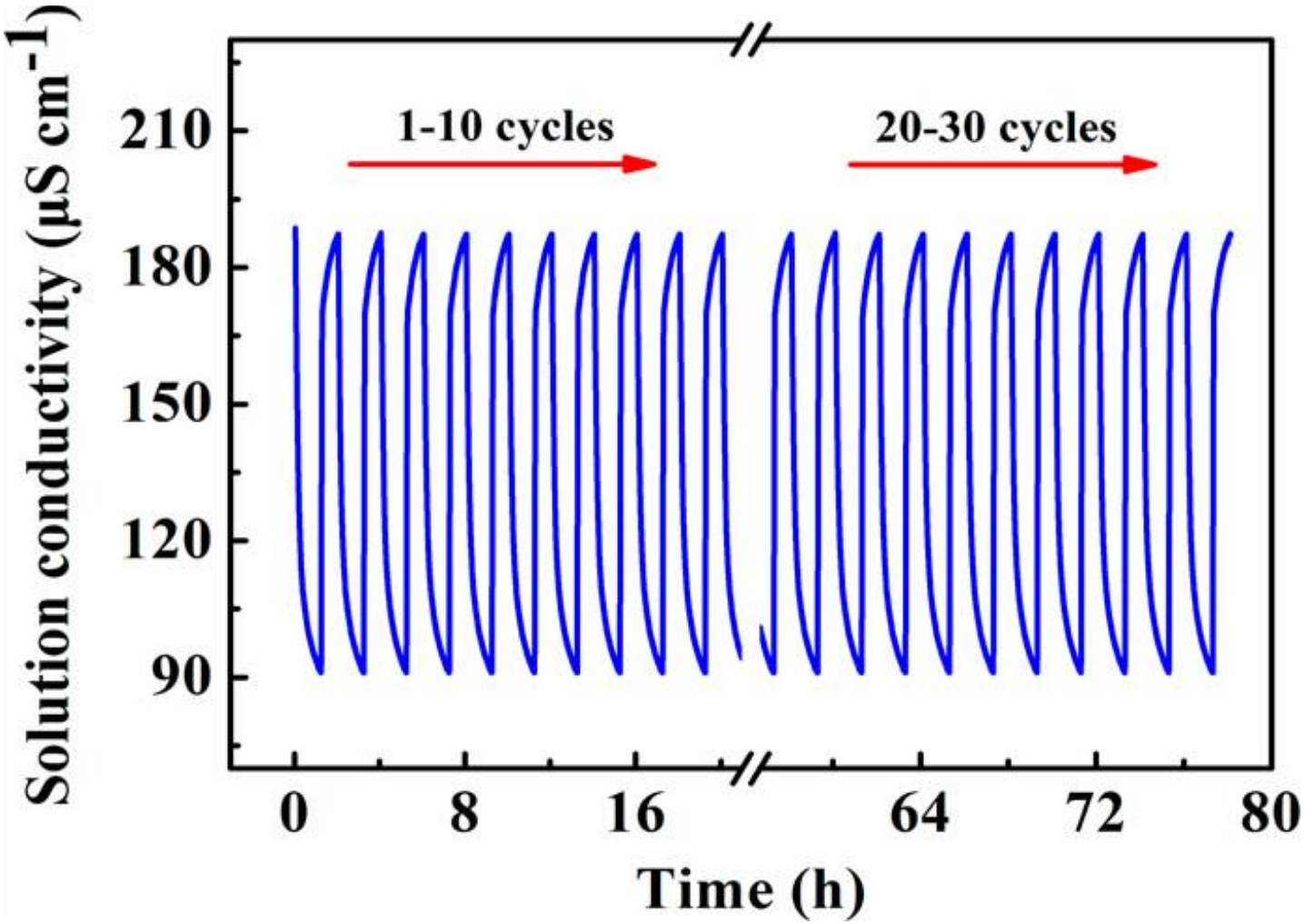


Fig 7. Regeneration performance of the NHPC electrode in a 100 mg/L NaCl solution at 1.4 V with a flow rate of 20 mL/min.

CONCLUSION

- The pores of dodecahedron-like carbon frameworks derived from ZIF-8 were in situ expanded via a surfactant-template strategy.

- The resultant NHPC exhibits a hierarchical pore structure with micro- and mesopores, large specific surface area, large pore volume, and high nitrogen content, good wettability, and high conductivity.

- The CDI experiments indicate that the NHPC electrode exhibits an extremely high salt adsorption capacity of **20.05 mg/g** at 1.4 V in a 500 mg/L NaCl solution, which is higher than that of NPC (13.01 mg/g) and larger capacity than those of graphene-based materials.

ChemComm

COMMUNICATION

View Article Online
View Journal | View Issue

Cite this: *Chem. Commun.*, 2017, 53, 881

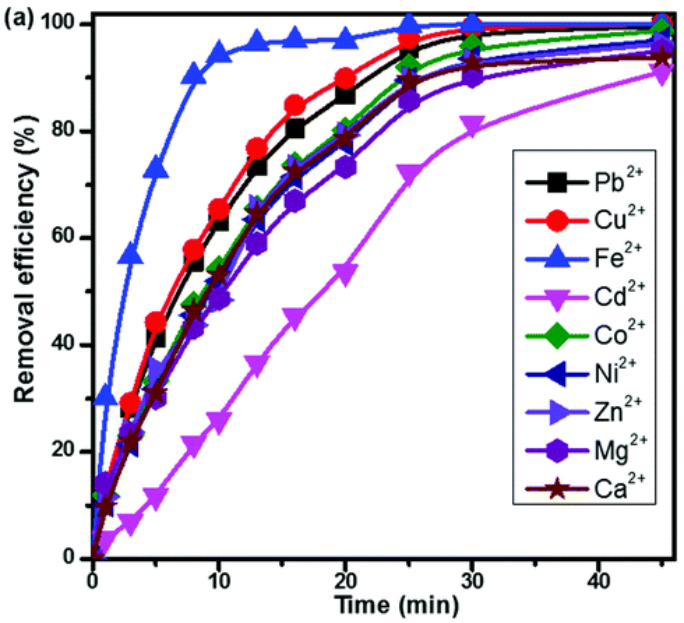
Received 24th October 2016,
Accepted 2nd December 2016

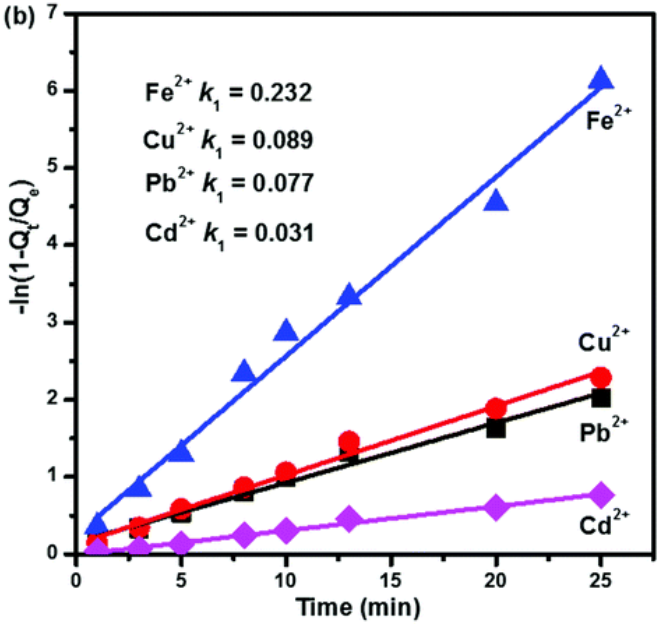
DOI: 10.1039/c6cc08515f

www.rsc.org/chemcomm

Highly porous N-doped graphene nanosheets for rapid removal of heavy metals from water by capacitive deionization†

Lianjun Liu,[a] Xiaoru Guo,[a] Rebecca Tallon,[b] Xingkang Huang[a] and Junhong Chen*[a]






Thank You