Electronic Supplementary Material (ESI) for Nanoscale. This journal is © The Royal Society of Chemistry 2022

Supporting information

Tailoring the Surface Chemistry of Hard Carbon Towards High-Efficiency Sodium Ion Storage

Chao Shen†[a], Chuan Wang†[ab], Ting Jin*[a], Xianggong Zhang*[b], Lifang Jiao*[c], Keyu Xie[a]

[a]*State Key Laboratory of Solidification Processing, Center for Nano Energy Materials, School of Materials Science and Engineering, Northwestern Polytechnical University and Shaanxi Joint Laboratory of Graphene (NPU) Xi'an 710072, P. R. China.*

[b]*Wuhan Institute of Marine Electric Propulsion, China Shipbuilding Industry Corporation, Wuhan 430064, China.*

[c]*Key Laboratory of Advanced Energy Materials Chemistry (Ministry of Education), Renewable Energy Conversion and Storage Center (ReCast), College of Chemistry, Nankai University, Tianjin 300071, China*.

†These authors contributed equally to this work.

Figure Captions

Fig. S1. The SEM images of (a) HC, (b) HCO-1, (c) HCO-2 and (d) HCO-3.

Fig. S2. NLDFT pore size distribution of HC, HCO-1, HCO-2 and HCO-3.

Fig. S3. The GITT curves of (a) HC and (b) HCO-2. The corresponding calculated Na^+ diffusion coefficients curves of (c) HC and (d) HCO-2.

Fig. S4. EIS spectra of original HC and HCO-2 electrodes and after (a) 0, (b) 50, (c) 500, and 1000 cycles.

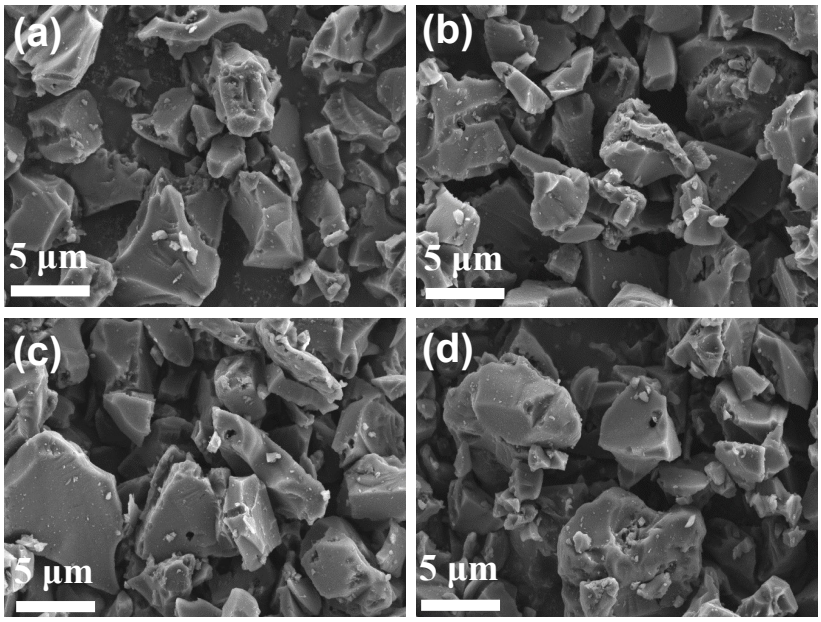

Fig. S1. The SEM images of (a) HC, (b) HCO-1, (c) HCO-2 and (d) HCO-3.

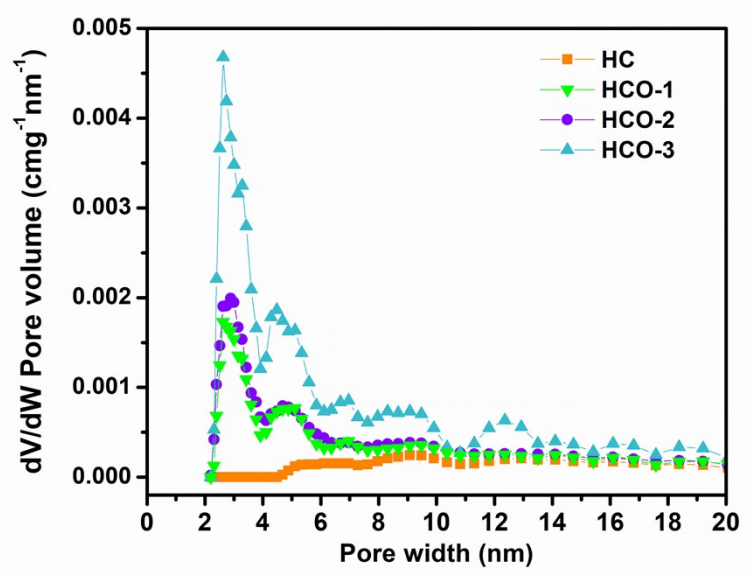

Fig. S2. NLDFT pore size distribution of HC, HCO-1, HCO-2 and HCO-3.

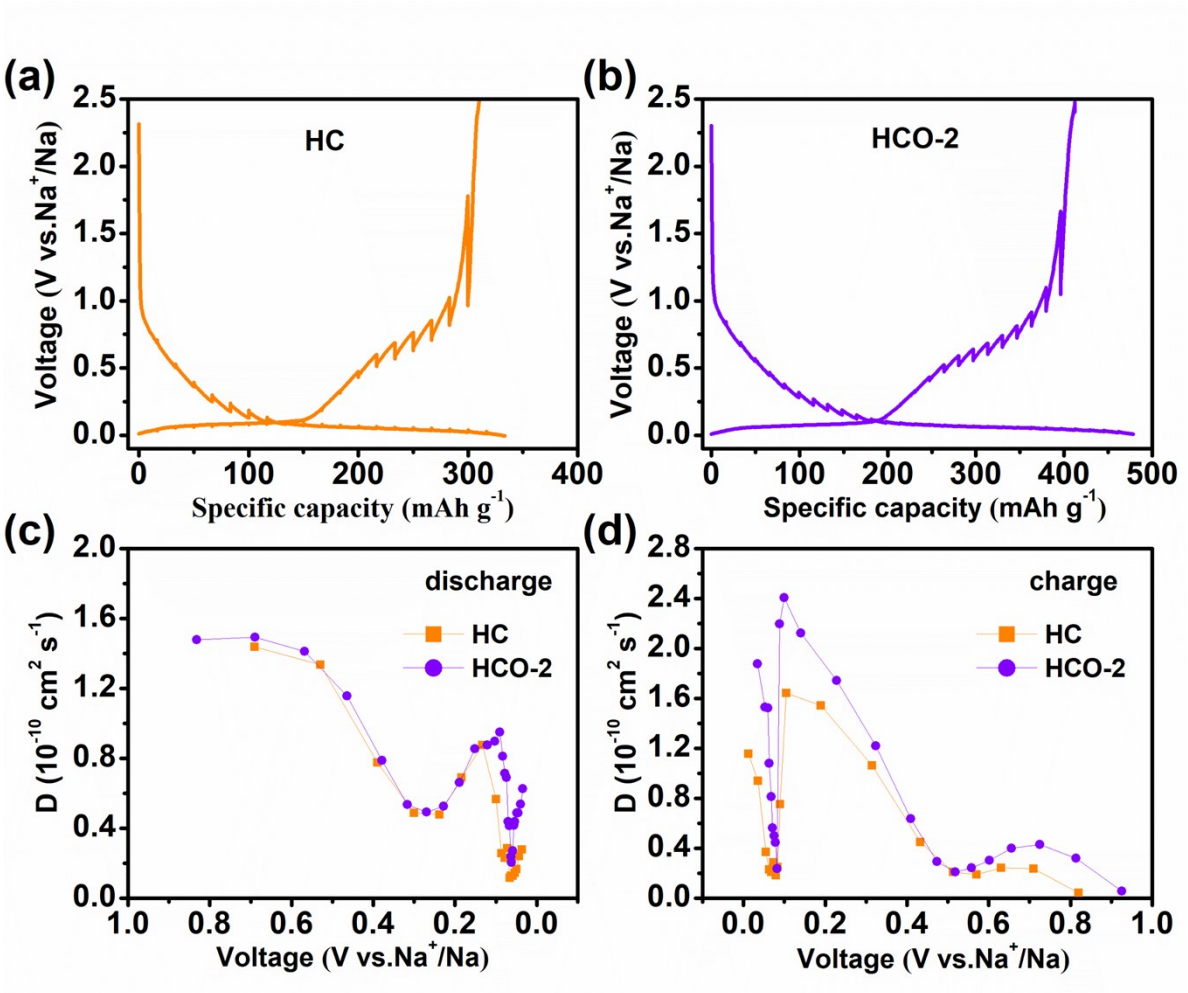

Fig. S3. The GITT curves of (a) HC and (b) HCO-2. The corresponding calculated Na^+ diffusion coefficients curves of (c) HC and (d) HCO-2.

The galvanostatic intermittent titration techniques (GITT) were performed to probe the Na^+ kinetics of HC and HCO-2 electrodes, the corresponding GITT curves are displayed in **Fig. S3a, b**. Based on the GITT data, the calculated Na^+ diffusion coefficient (D_{Na^+}) in HC and HCO-2 are shown in **Fig. S3c, d**. It can be found that the D_{Na^+} for HCO-2 is slightly higher than that for HC, demonstrating the faster Na^+ diffusion in HCO-2.

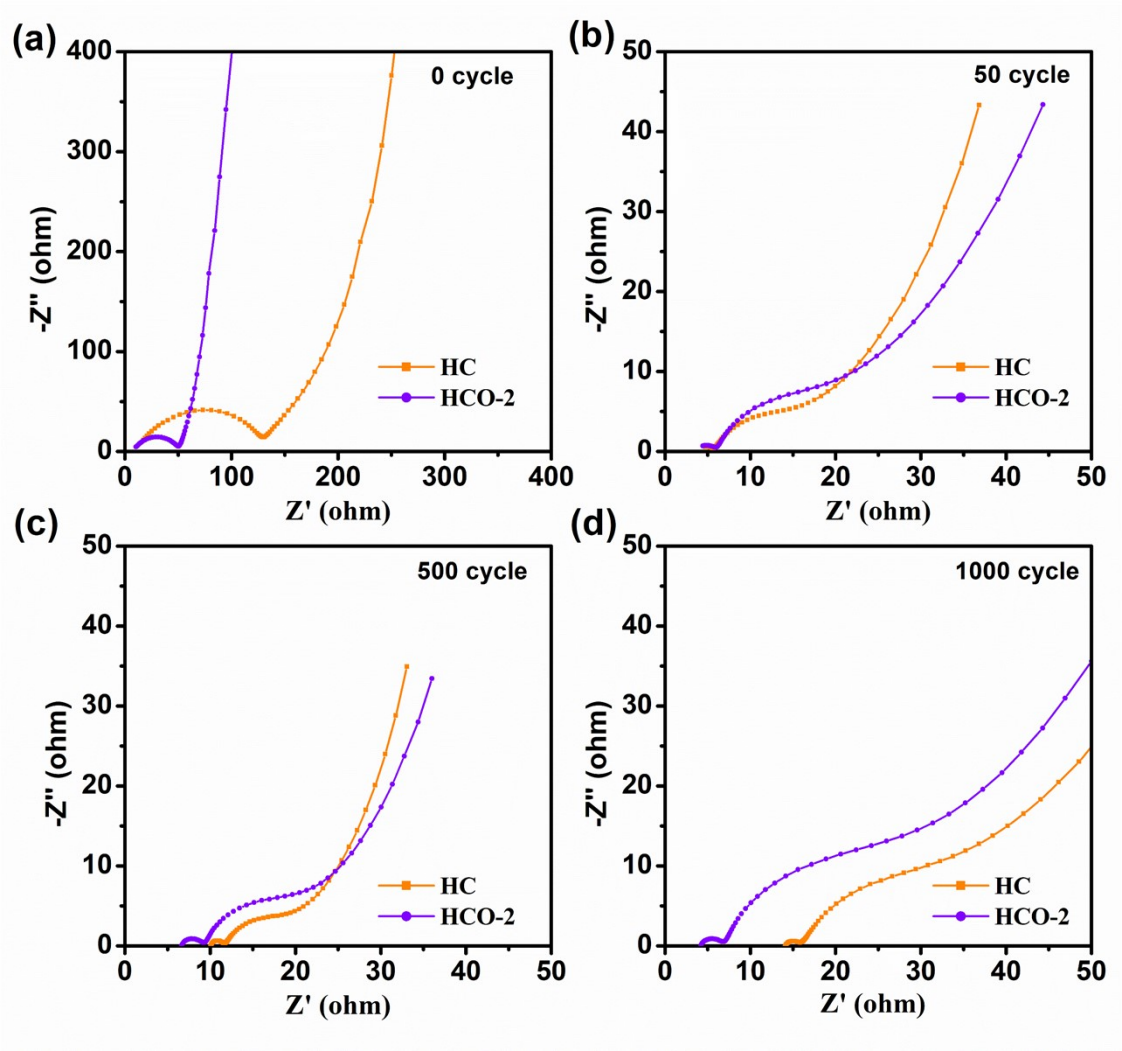

Fig. S4. EIS spectra of original HC and HCO-2 electrodes and after (a) 0, (b) 50, (c) 500, and 1000 cycles.

Fig. S4 presents the EIS spectra of original HC and HCO-2 electrodes and after 50, 500 and 1000 cycles. All spectra curves contain one semicircle in the high-medium frequency referred to the resistance of SEI film (R_{SEI}) and the charge-transfer resistance (R_{ct}), and a slope at low frequency related to solid state diffusion of sodium ions in electrode materials. It can be clearly seen that the much smaller semicircle diameter in HCO-2 than HC whether before or after cycles, suggesting the significantly reduced interface resistance of samples after LTOP treatment.