

Supplementary Materials for

Sodium storage in hard carbon with curved graphene platelets as the basic structural units

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Table of Contents:

- I. Supplementary Figures S1 to S7
- II. Supplementary Formula S1 to S4
- III. Supplementary Video S1

I. Supplementary Figure



Fig. S1 Photographs of sweet-gum tree and sweet gum.

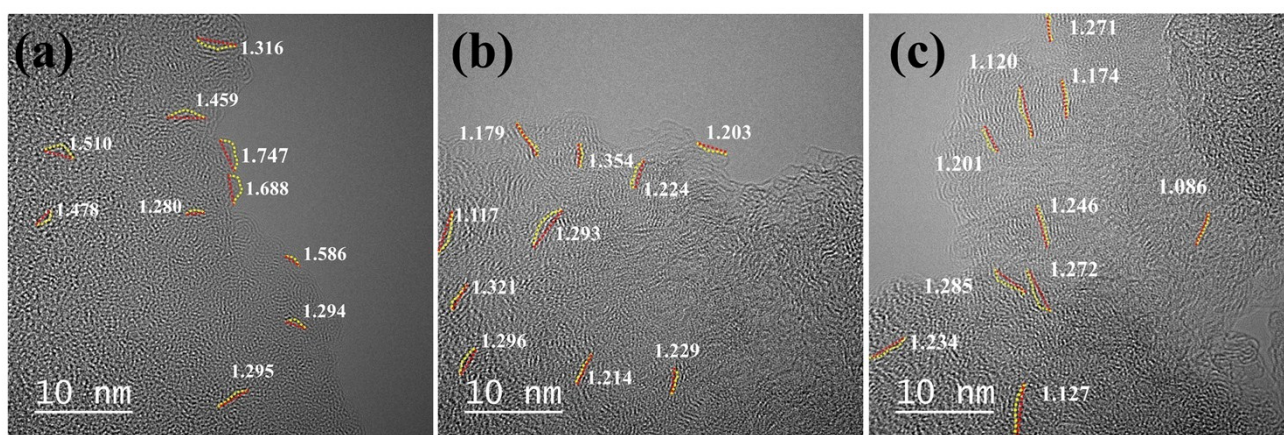


Fig. S2 The curvature of graphene layer measured for the hard carbon processed at (a) 800, (b) 1000 and (c) 1200°C. The curvature is measured by dividing the actual length of a graphene (yellow dotted lines) with the length of the straight line connecting the beginning and ending points (red dotted lines).

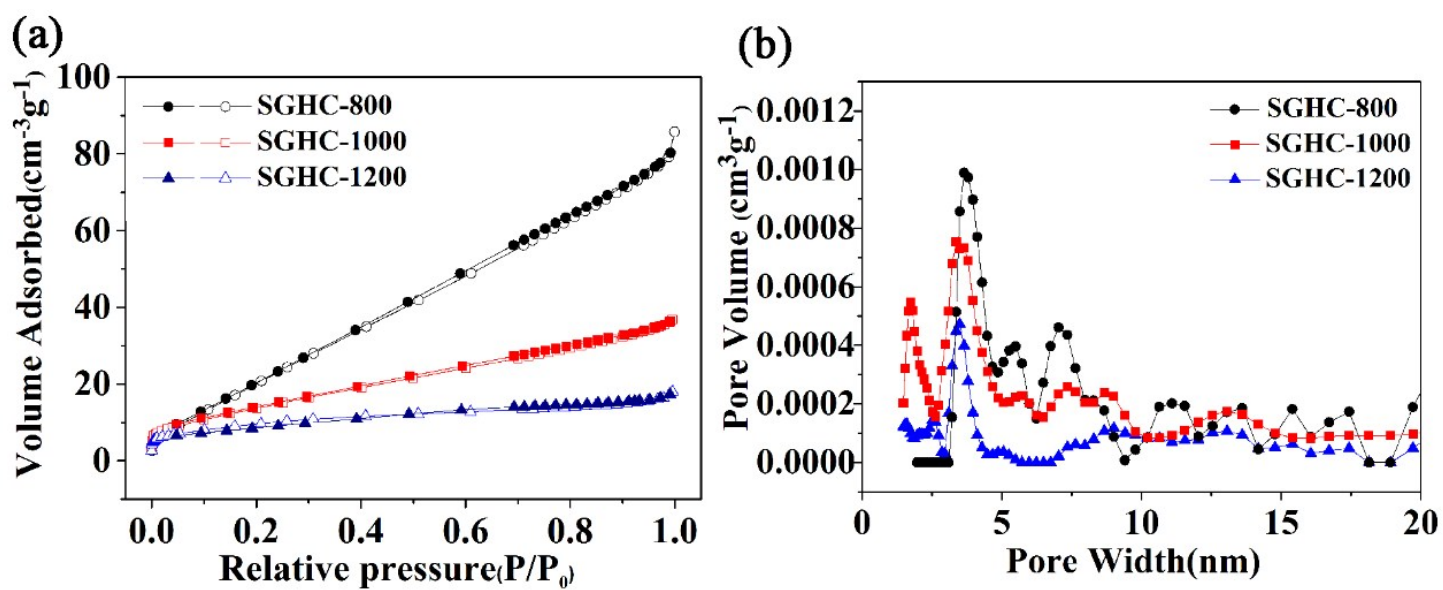


Fig. S3 N_2 adsorption/desorption isotherms (a) and the pore size distribution curve (b) of SGHC-800, SGHC-1000 and SGHC-1200.

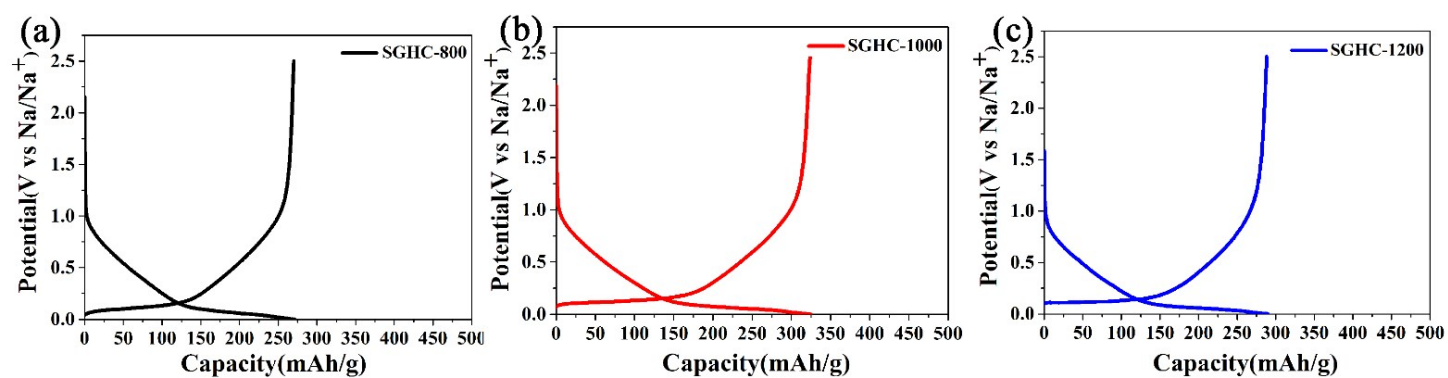


Fig. S4 Discharge/charge curves of (a) SGHC-800, (b) SGHC-1000 and (c) SGHC-1200 at a current density of 50 mA g⁻¹ for 40th cycle.

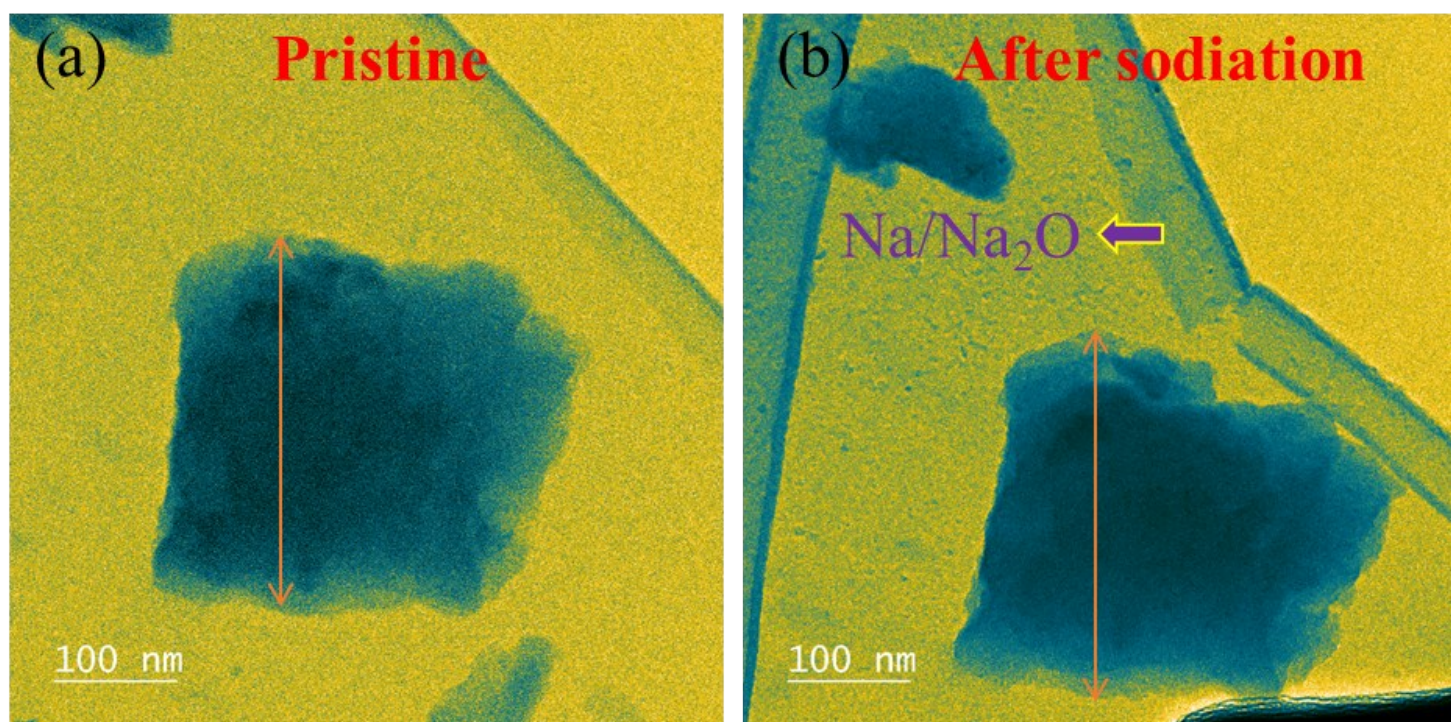


Fig. S5 Low-magnification TEM image of SGHC-1000 particle, before sodiation (a) and after sodiation (b).

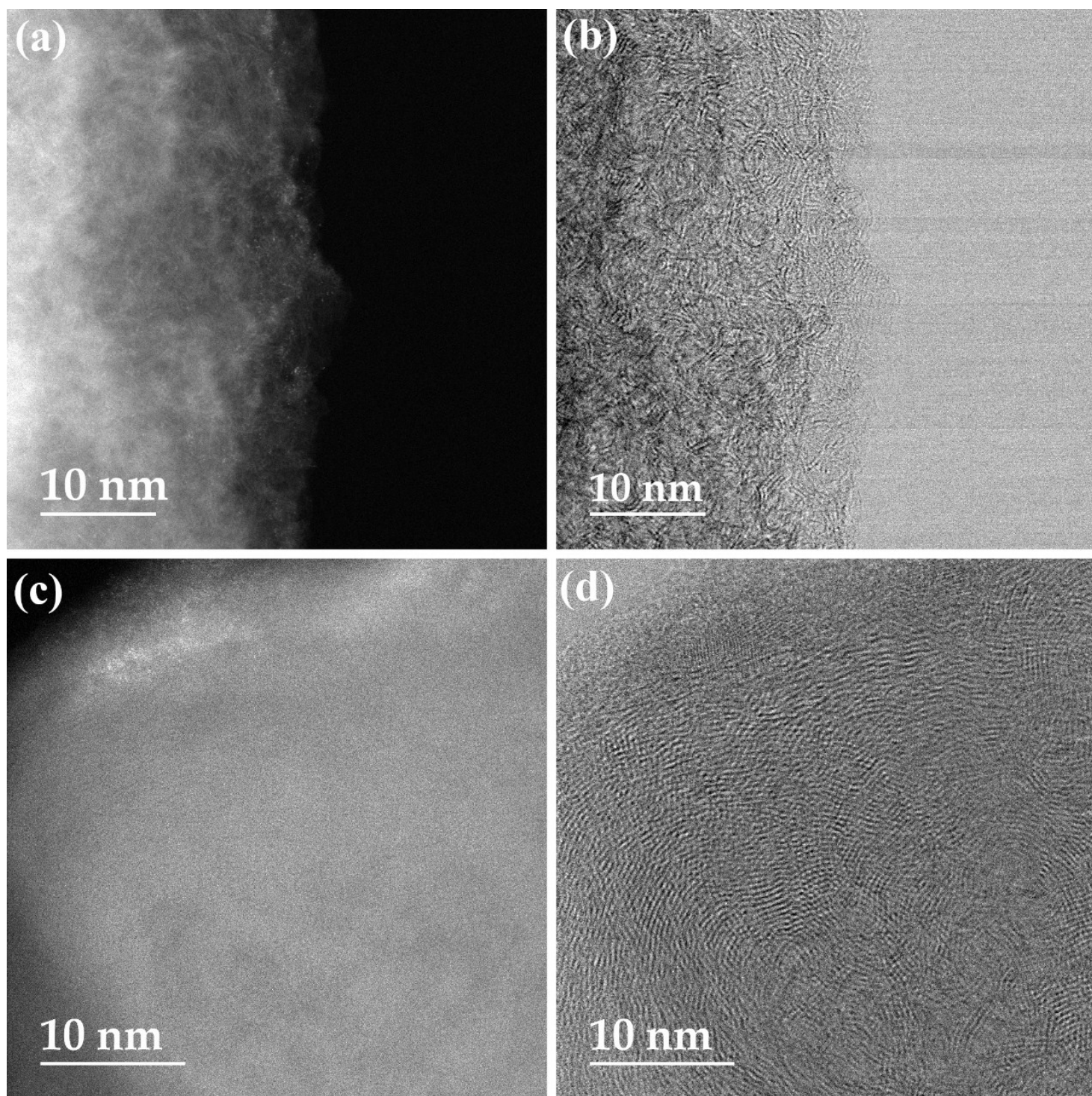


Fig. S6 STEM images of a pristine SGHC-1000 particle before cycle collected by a high-angle annular dark field detector (a) and a bright field detector (b). STEM images of a SGHC-1000 particle cycled 100 cycles at a current density of 50 mA g^{-1} collected by a high-angle annular dark field detector (c) and a bright field detector (d).

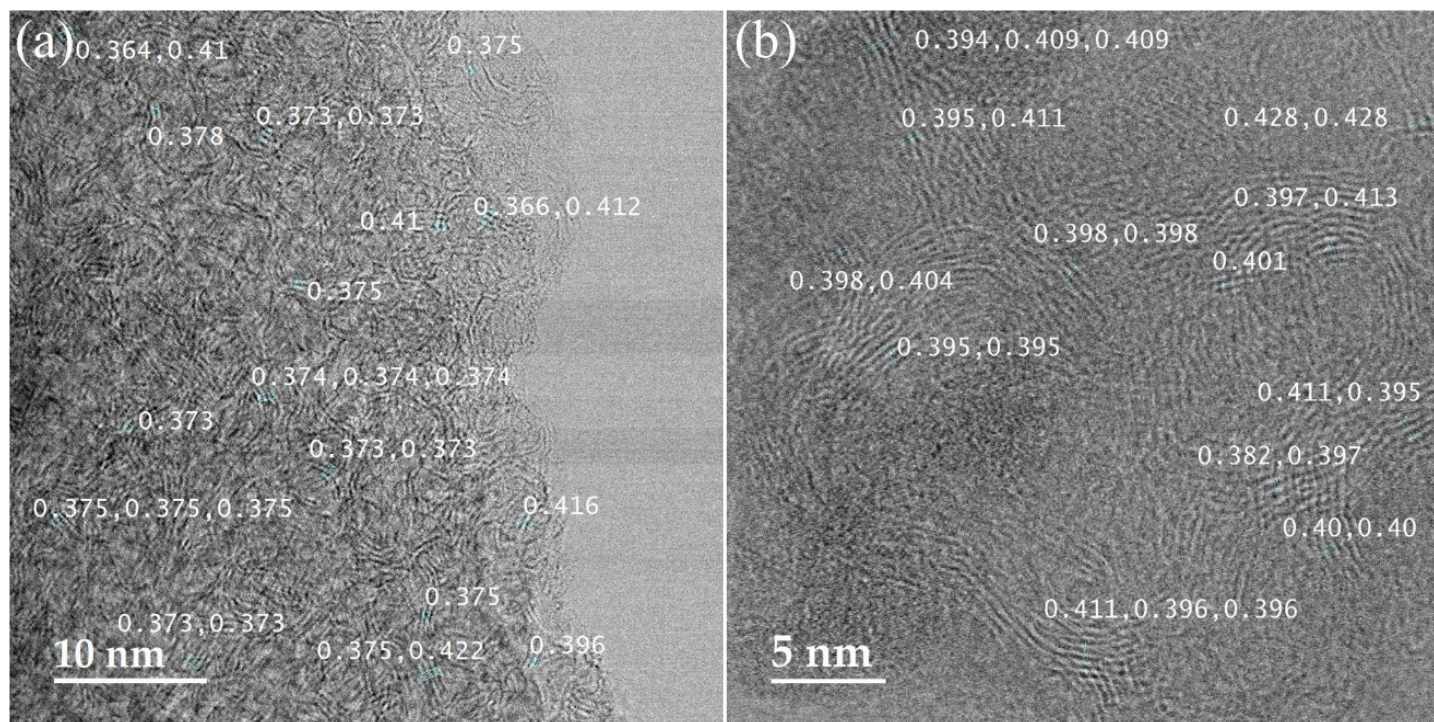


Fig. S7 STEM images of a SGHC-1000 particle before cycle (a), after 100 cycles at a current density of 50 mA g⁻¹ (b). The graphene interlayer distance are measured and labeled.

II. Formula for parameters of hard carbon

$$d_{002} = \frac{\gamma}{2\sin\theta_{002}} \quad \text{S1}$$

$$Lc = \frac{0.89 * \gamma}{B_{002} * \cos\theta_{002}} \quad \text{S2}$$

$$n = \frac{Lc}{d_{002}} \quad \text{S3}$$

$$La = \frac{1.77 * \gamma}{B_{100} * \cos\theta_{100}} \quad \text{S4}$$

The parameters (graphene interlayer distance d_{002} , thickness of graphene layers Lc , number of graphene layers n , average lateral length La) are calculated from the x-ray diffraction spectra, where λ is the wavelength of Cu $K\alpha$ radiation, θ is the diffraction angle in radians, and B is the half maximum intensity in radians.

III. Supplementary Video

Video S1. In-situ TEM observation of sodiation of SGHC-1000 hard carbon particle under a potential bias of -3V. The frame speed is 64-times faster than real time.