Supplementary Information

Long-cyclic anode based on coral-like Sn nanostructure with binary binder

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Experimental procedures

1. Synthesis of Coral-like Sn

The coral-like Sn was prepared through a simple displacement reaction: $4Li + SnCl_4 = Sn + 4LiCl$. Briefly, 25 pieces of lithium foils (commercially available lithium foils used for LIBs, 20 mg each) were cut into small pieces and transferred into a two-necked flask filled with 50 mL anhydrous m-xylene solution (Sigma-Aldrich) in a glovebox. Next, 5 mL anhydrous $SnCl_4$ (98%, Sigma-Aldrich) was injected slowly using a syringe under vigorous stirring. After 25 h stirring under argon atmosphere, the mixture was filtered to remove the solid residues, and the gray-black suspension was redispersed in 300 mL ethanol. Finally, the product was collected by centrifugation, and then washed with ethanol/water for several times. The obtained grayish powder was dried in a vacuum oven at 80 ℃ for 12 h.

2. Materials Characterization

Powder XRD was recorded by a Bruker D8 Advance diffractometer with Cu K_α radiation (λ=0.154056 nm). SEM images were collected using a scanning electron microscopy (JEOL JSM-6700F) at an accelerating voltage of 10 kV. TEM analysis was performed by a transmission electron microscopy (FEI Tecnai G^2 F30) at an accelerating voltage of 300 kV. The elastic modulus was measured using a nanoindentation (Hysitron TI980) at a load of 10 mN.

3. Electrochemical Measurements

For electrochemical tests, the working electrodes were fabricated by mixing active material (coral-like Sn), conductive material (acetylene black) and binder (NaCMC, NaCMC/GO, or GO) into deionized water (See Table S1 for details). The slurry was then uniformly coated on a copper foil and dried in a vacuum oven at 100 °C for 12 h. The as-prepared films were punched into disk electrodes (d = 12 mm), and the active material loaded on each electrode was determined to be ~1 mg cm^{-2}. Coin-type cells were assembled using lithium foil as the counter electrode, Celgard@2400 polypropylene member as the separator, respectively. 1 M $LiPF_6$ in a complex solvent (ethylene carbonate, ethyl methyl carbonate and dimethyl carbonate with volume ratio of 1:1:1) was applied as the electrolyte. All the coin cells were assembled in a

glovebox with both H_2O and O_2 content less than 0.1 ppm. Electrochemical tests were measured with CHI 760D electrochemical workstation and NEWARE battery analyzer after ageing for 12 h.

Table S1. The mass ratio of electrode components used in slurry coating technique.

Sample	Sn powder (wt%)	Acetylene black (wt%)	NaCMC (wt%)	GO (wt%)
10% NaCMC	70	20	10	0
5% NaCMC/5% GO	70	20	5	5
10% GO	70	20	0	10

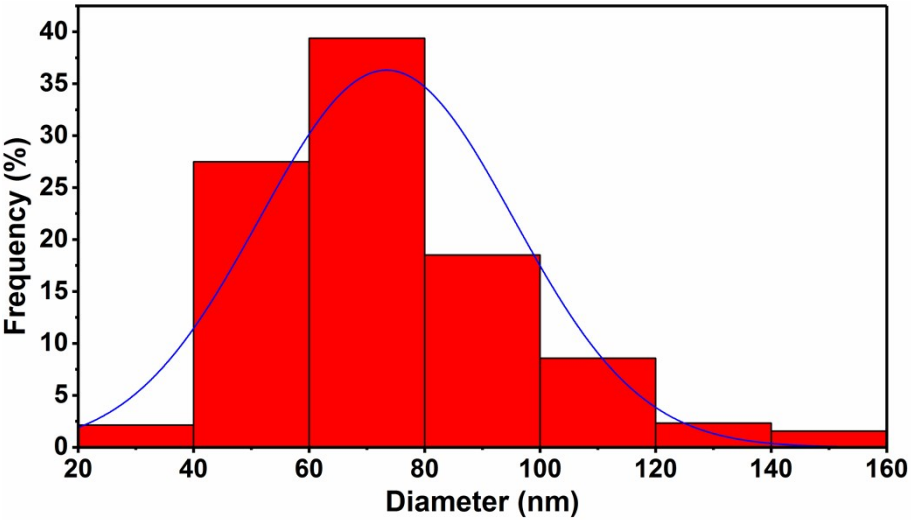

Fig. S1 Size distribution histogram of the as-obtained coral-like metallic Sn.

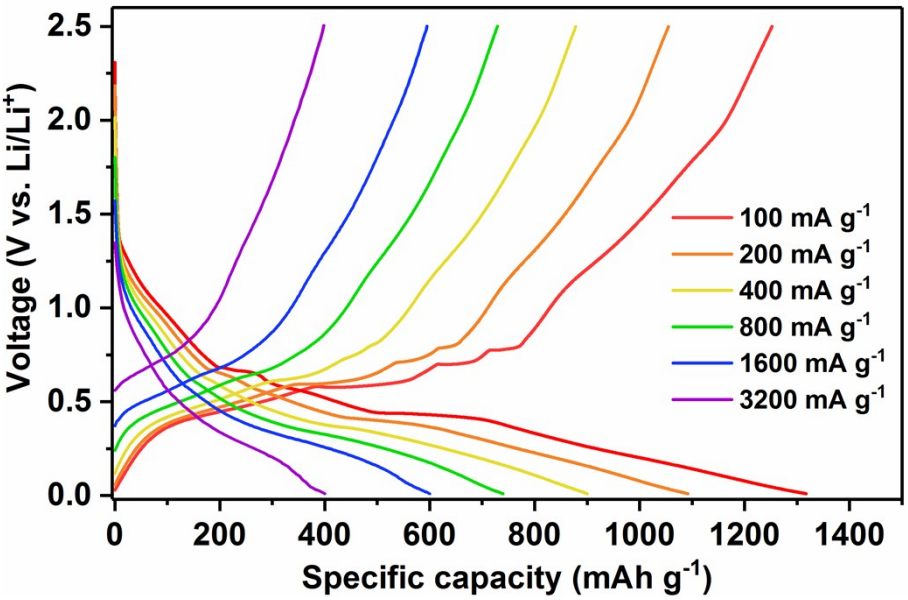

Fig. S2 The charge-discharge profiles of the 5 wt% NaCMC/5 wt% GO binder electrode at various current densities.

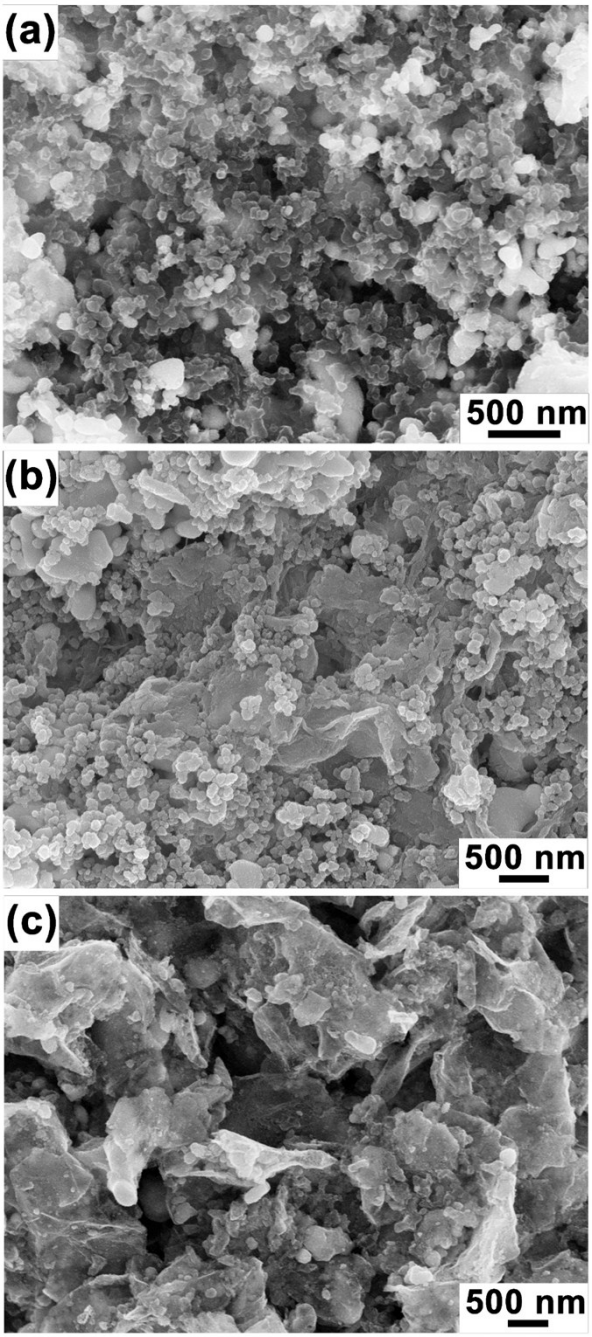

Fig. S3 SEM images of fresh electrodes prepared with (a) 10 wt% NaCMC, (b) 5 wt% NaCMC/5 wt% GO, and (c) 10 wt% GO binders, respectively.

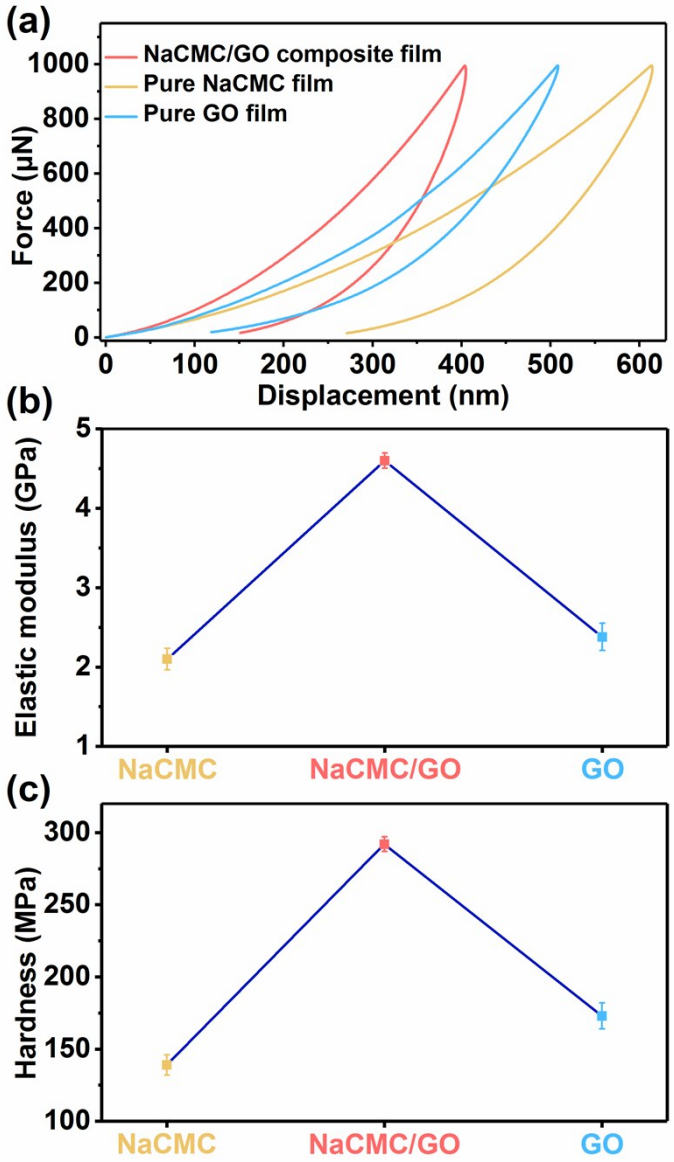

Fig. S4 (a) The force-displacement curve, (b) elastic modulus and (c) hardness of the NaCMC, GO and NaCMC/GO composite films at a load of 10 mN.

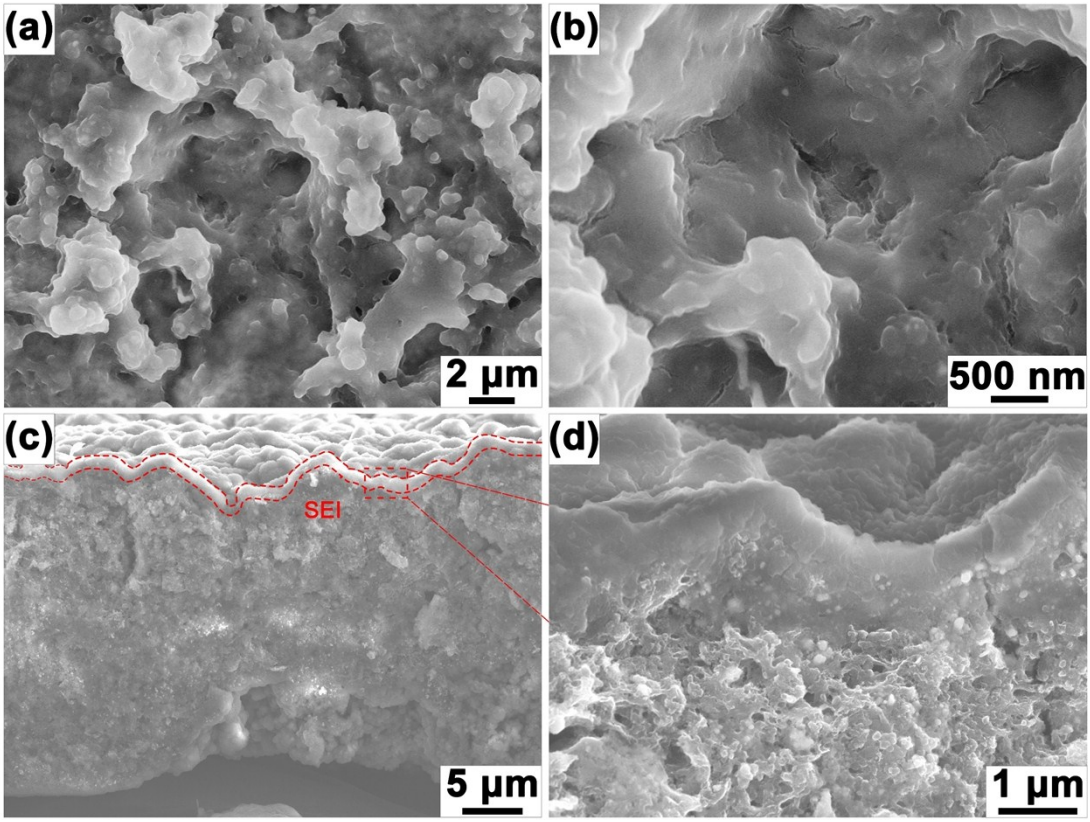

Fig. S5 (a, b) Surface and (c, d) cross-section SEM images of the 5 wt% NaCMC/5 wt% GO binder electrode after 50 cycles at a current density of 500 mA g^{-1}.