

Supporting Information

Bimetal-organic-framework derived CoTiO₃/C hexagonal micro-prisms with high pseudocapacitance as high-performance anode materials for Metal ion batteries

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Electrochemical measurements

The electrochemical performance tests of as-prepared carbon-doped CoTiO₃ micro-prisms were performed in half cell (metal sodium plate as anode, 1.0 mol dm⁻³ NaClO₄ solution of propylene carbonate as electrolyte solution). The active materials uniformly mixed with acetylene black (AB) and sodium alginate (SA) (active material:AB:SA = 8:1:1). The mixed materials were uniformly applied over the Cu foils and dried for 24h at 60°C. The galvanostatic charge-discharge measurements were carried out on NEWARE battery test system in the range of 0.01-2.5V. Cyclic voltammetry (CV) measurements were tested in a voltage range of 0.01-2.5V at a scanning rate of 0.2mV s⁻¹. Electrochemical impedance spectroscopy (EIS) was carried out in a frequency range of 0.01Hz to 100kHz. Both the EIS and CV measurements were performed on a Autolab PG302N electrochemical workstation.

Characterization

The powder X-ray diffraction (XRD) patterns were characterized using Bruker Advance-D8 diffractometer with Cu (K α) radiation. GSAS software was used to refine the unit cell parameters based on the Rietveld method. The content of metal element were confirmed by means of inductively-coupled plasma-atomic emission spectrometry (ICP-AES) analysis on a Perkin Elmer type instrument (Optima5300DV). Scanning electron microscopy images (SEM) measurements were carried out on a FEI Nova Nano SEM 230 equipment. JEOL-2100F electron microscope and FEI Tecnai F20 electron microscope were used to obtain Transmission electron microscopy (TEM) images, EDS maps and high-resolution scanning transmission electron microscopy (STEM) images. X-ray photoelectron spectroscopy (XPS) analysis was collected on an ESCALAB MK II X-ray photoelectron spectrometer using Mg K α radiation.

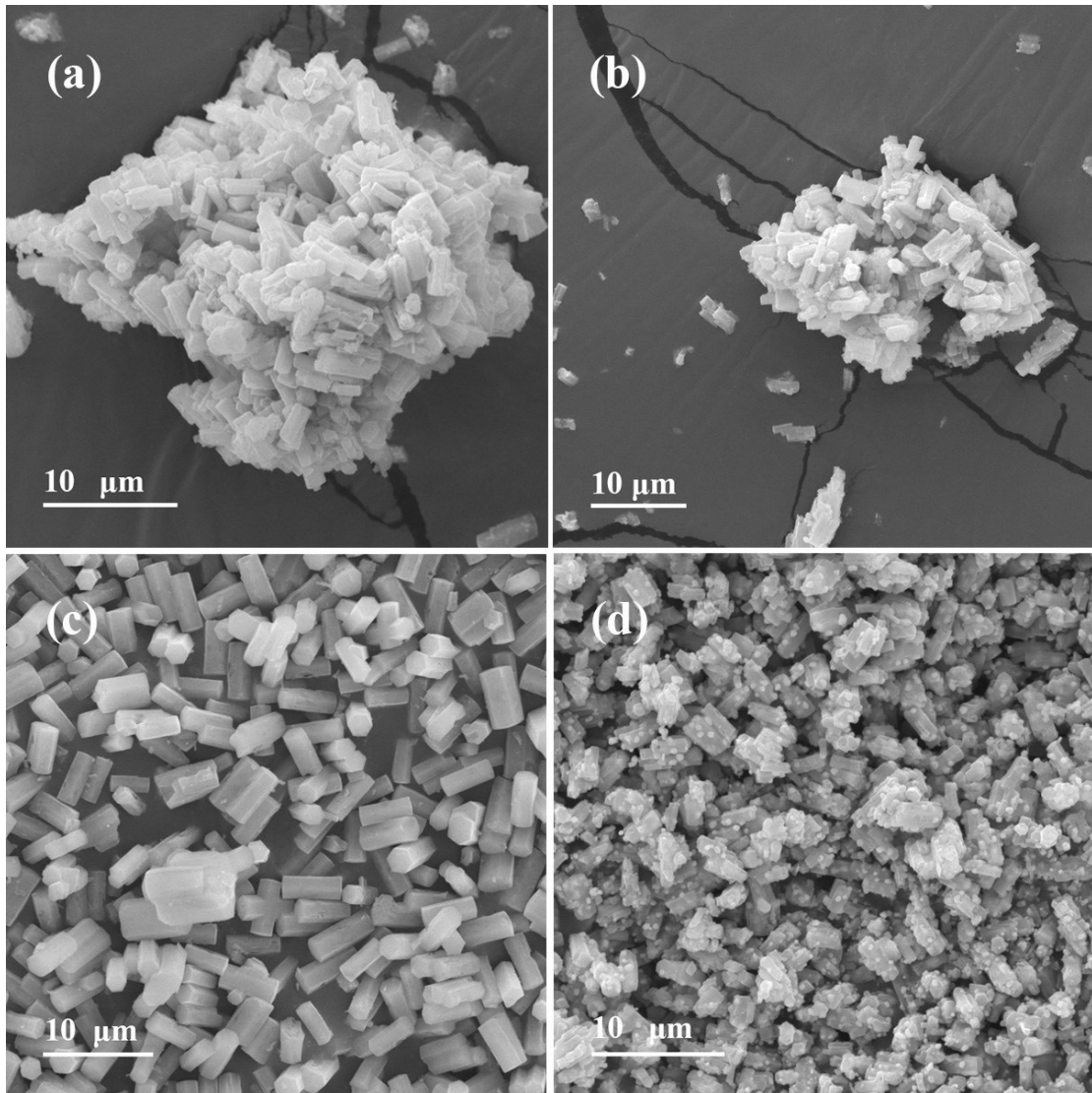


Figure 1S SEM images of CoTiO₃/C obtained by annealing Ni-Ti-EG precursor at different temperature for 30min in Ar atmosphere (a)400°C; (b)500°C; (c)600°C; (d)700°C

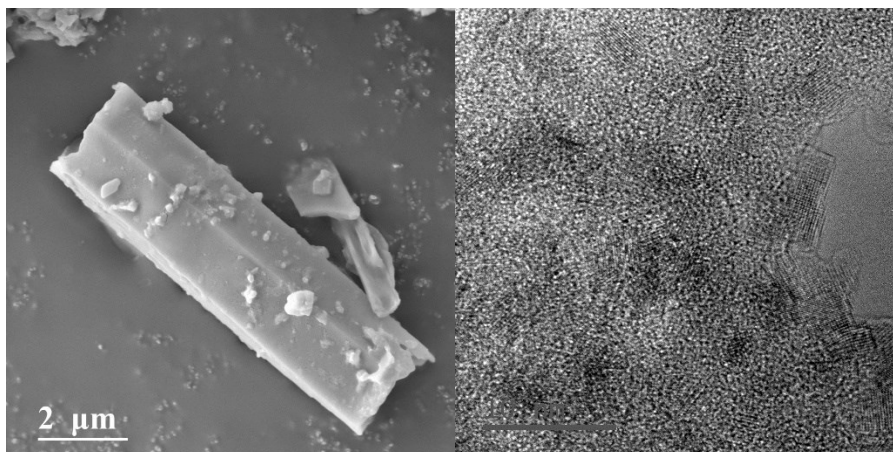


Figure 2S (a) SEM images of six prism Co-Ti-EG precursor. (b) The high resolution STEM images of CoTiO_3/C .

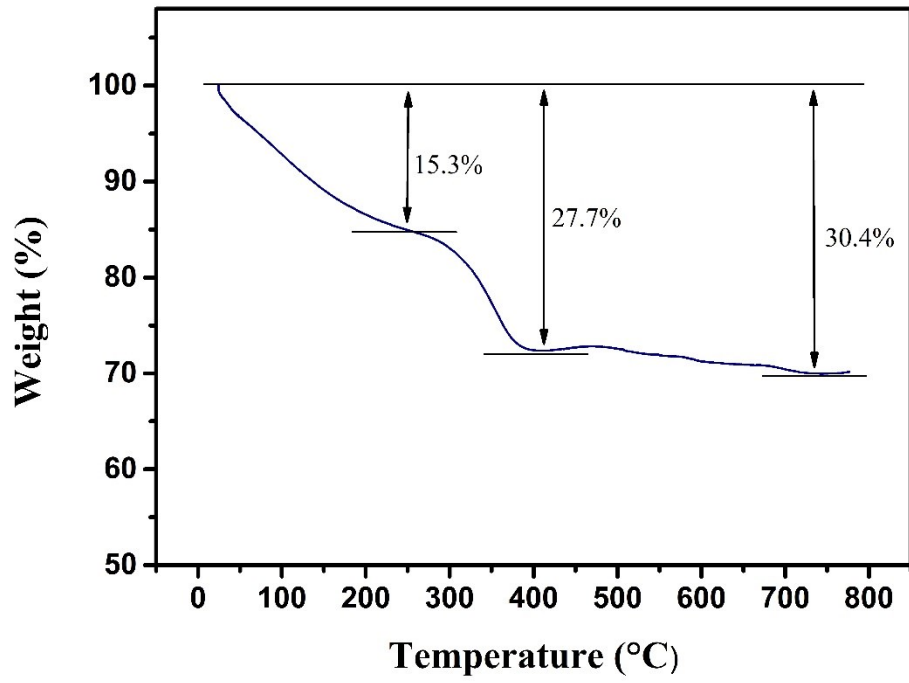


Figure 3S (a) The TGA curve of CoTiO₃/C microprisms.

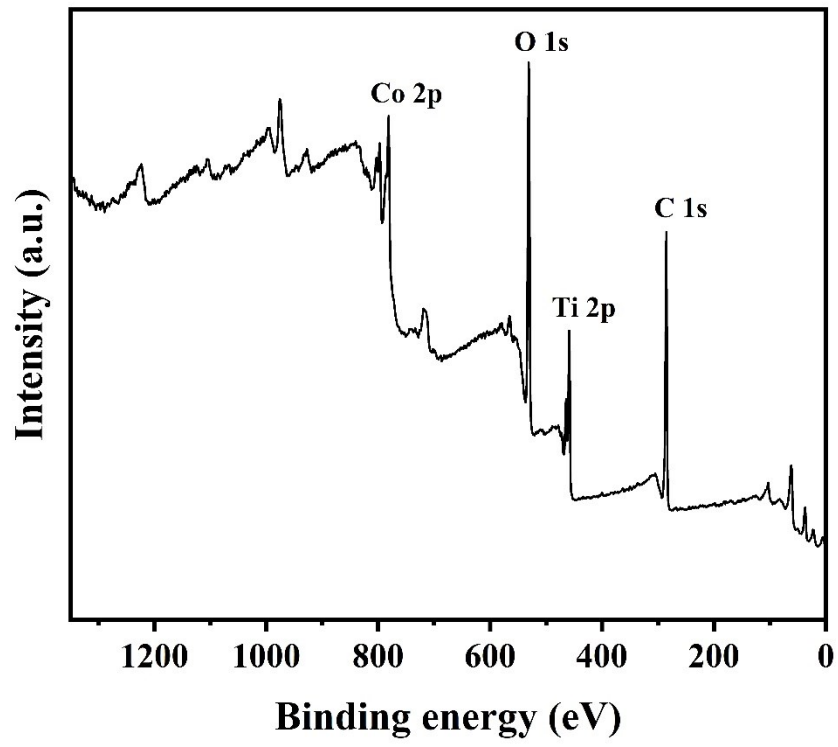


Figure 4S The XPS spectra of CoTiO₃/C.

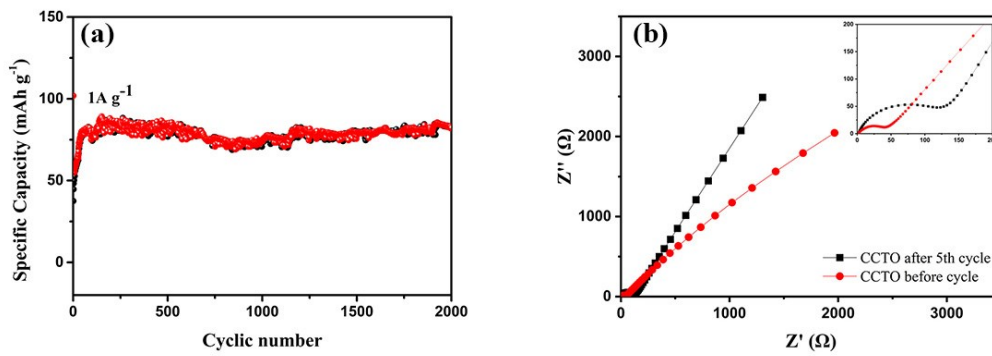


Figure 5S (a) Long-term cyclic performance of CoTiO_3/C in sodium battery at a current density of 1A g^{-1} (b) electrochemical impedance spectroscopy (EIS) measurements of CoTiO_3/C before and after 5 cycles.

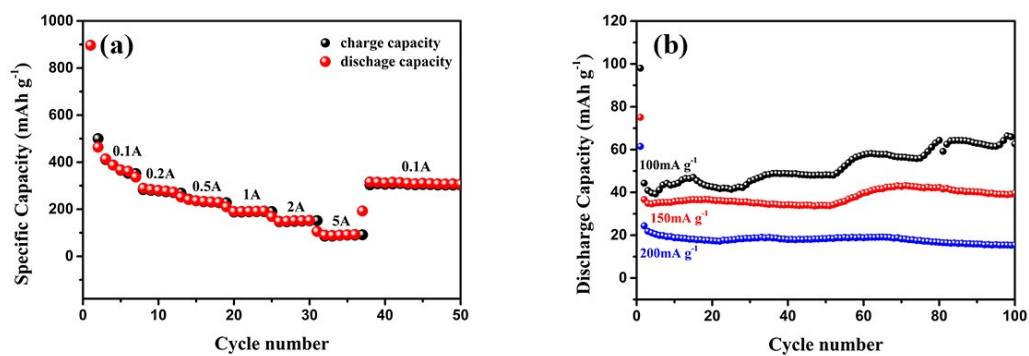


Figure 6S (a) Rate performance of CoTiO₃/C in lithium battery at a current density of 0.1, 0.2, 0.5, 1, 2, 5A g⁻¹, respectively. (b) cyclic and rate capacity for the CoTiO₃/C in potassium battery at a current density of 0.1, 0.15, 0.2A g⁻¹, respectively.

Table S1 Various element contents of CoTiO₃/C by mapping refinements.

Elements	Mass ratio (%)	Atom ratio (%)
C	16.48	39.30
O	12.66	22.68
Ti	32.00	19.13
Co	38.86	18.89