Supporting information (SI)

Electrochemical studies of crystalline CuS as an electrode material for non-aquous Na-ion capacitor

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Instrumentations

Powder X-ray diffraction (XRD) of as-prepared samples was performed using X-ray powder diffraction (Rigaku Miniflex II.; Cu K_α radiation λ=1.5418 Å) at a scan rate of 0.02^o s^{-1}. Functional group analysis was performed FT-IR analysis using a Thermoscientific Nicolet IS50 FTIR spectrophotometer. The morphology and surface study of the sample was characterized by field emission scanning electron microscopy (FE-SEM, Nova Nano SEM 430) and transmission electron microscopy (TEM). BET surface measurement was performed by Smart SORB 92193 set-up.

Electrochemical measurement

Electrochemical characterization of CuS particle is investigated using CR2032 type coin cells (half-cells) with sodium ingot as the reference and counter electrode. Celgard 2400 is used as the separator and the electrolyte, 1M $NaClO_4$ is dissolved in a mixture of 1:1 (vol. ratio) ethylene carbonate (EC)-diethyl carbonate (DEC). The working electrode is prepared by

using traditional slurry coating method in which it consists of the synthesized active material, super-p carbon and polyvinylidene fluoride (PVDF binder) in the weight ratio of 80: 10: 10 in N-methyl-2-pyrollidone as a solvent. As-prepared slurry is coated uniformly onto the copper foil and the electrodes are dried in hot air oven at 120°C overnight. The circular discs of 18 mm dia are punched out and used as the working electrode. Argon filled glove box (Vigor, China) is used for assembling the sodium-ion half-cell. Galvanostatic charge-discharge measurements and cyclic voltammetry (CV) are carried out at room temperature using NEWARE battery analyzer (China) and Biologic electrochemical workstation (Biologic SAS, France), respectively. The potential window is used between 0.01 and 3V at different current densities (0.1 to 5 Ag^{-1}) and scan rates (0.1 to 100 mVs^{-1}), respectively. Electrochemical impedance spectroscopy (EIS) is carried out using Biologic electrochemical workstation (Biologic SAS, France) in which AC voltage amplitude of 5 mV and the frequency range between 100 KHz and 5 mHz.

Figure S1. EDAX pattern of synthesized CuS particles.

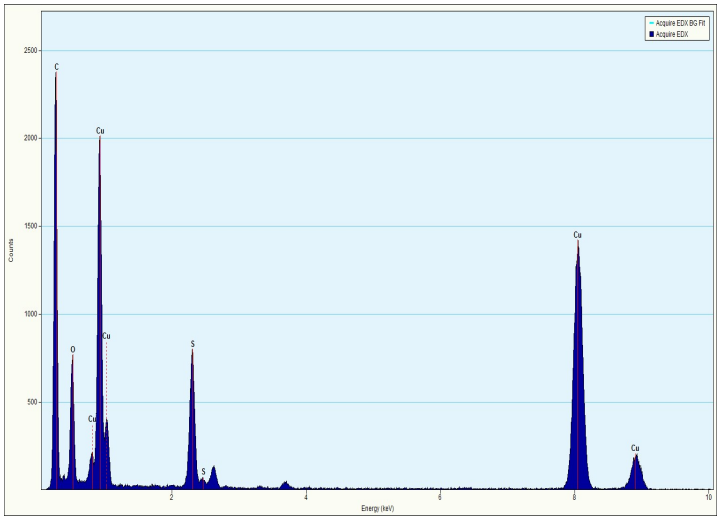


Figure S2. N_2 adsorption and desorption isotherm of CuS particles

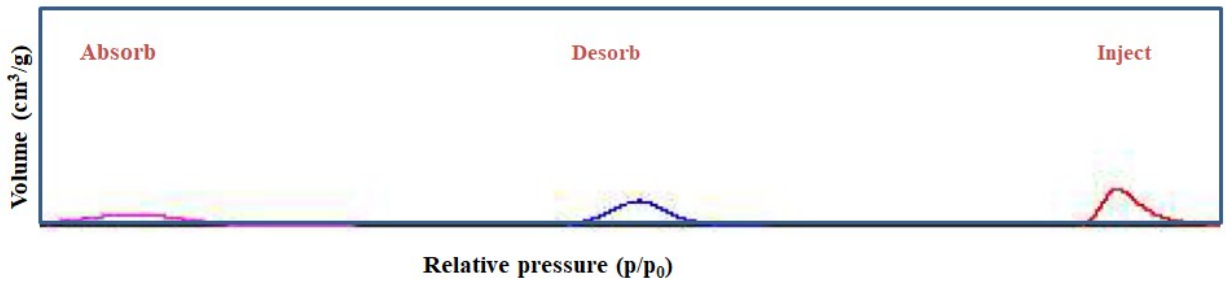


Figure S3. SEAD pattern of synthesized CuS

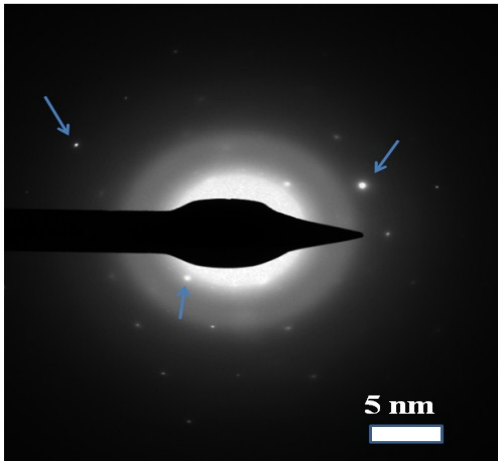
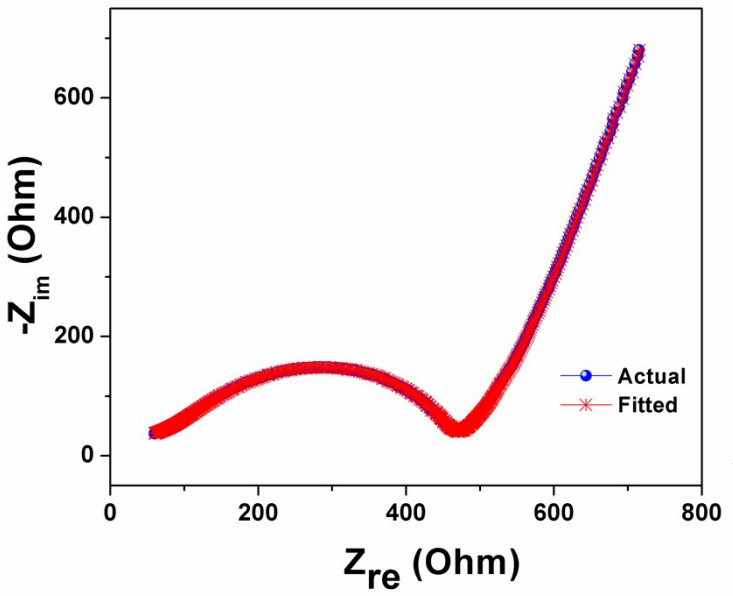
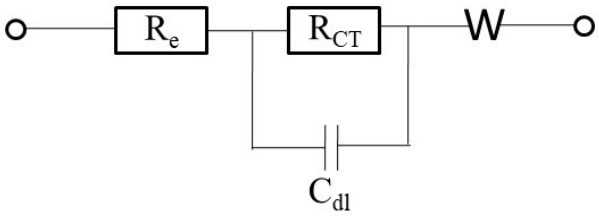


Figure S4. Electrochemical impedance spectroscopy (EIS) study of synthesized CuS nanoparticles.





S. No	R_s	R_{ct}	C_{dl}
1	59 Ω	410 Ω	1.49 µF

Figure S5. Charge-discharge profile of synthesized CuS nanoparticles