Electronic supplementary information (ESI)

Aqueous Na-ion capacitor with CuS graphene composite in symmetric and asymmetric configurations

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Instrumentations

Powder X-ray diffraction (PXRD) of as-prepared sample (CuS) was performed on Rigaku Miniflex II.; Cu K_α radiation λ=1.5418 Å at a scan rate of 0.02° s^{-1}. Functional group analysis was performed by FT-IR (Thermoscientific Nicolet IS50 FT-IR spectrophotometer). The morphology, surface study and mapping of the sample was characterized by field emission scanning electron microscopy (FE-SEM, Nova Nano SEM 430) equipped with an energy-dispersive X-ray spectrometer (EDAX) and transmission electron microscopy (TEM, JEM F-200). BET surface measurement was performed by St 2 on NOVA touch 2LX. X-ray photoelectron spectroscopic (XPS) analysis (AXIS-ULTRA DLD) and Raman spectroscopic (STR 500) analysis were used to know the chemical composition of CuS and CuS-G sample.
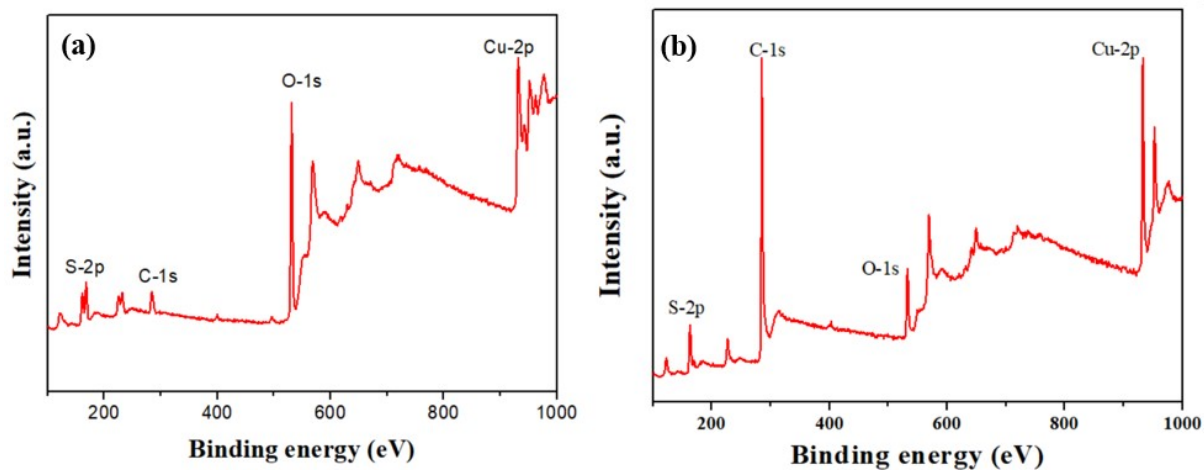
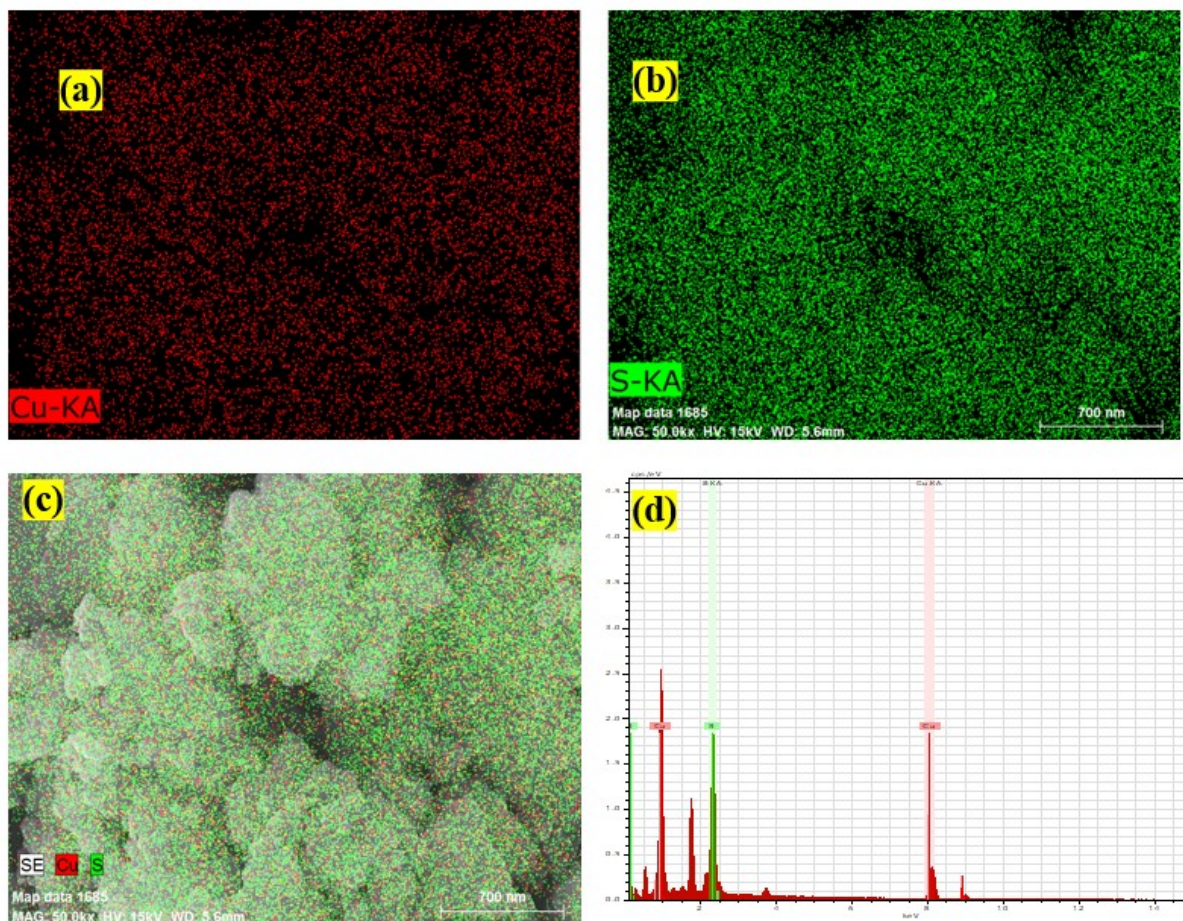**Figure S1** Wide XPS survey of CuS (a) and CuS-G (b) sample.

Figure S2 Mapping was performed to ensure the presence of copper (a), sulphur (b), CuS (c) with the EDAX (d) of CuS sample.
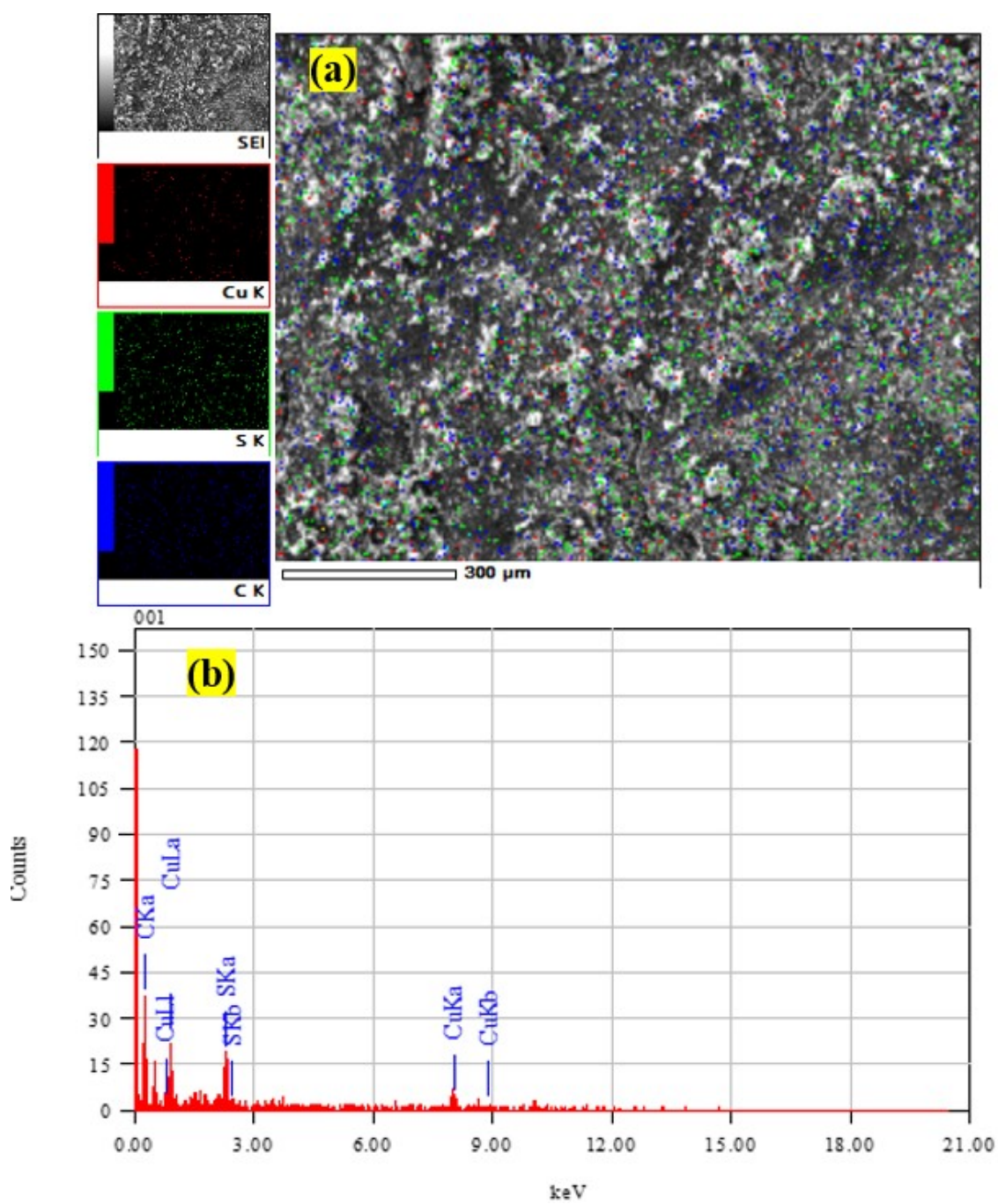
Figure S3 Mapping was performed to ensure the presence copper, sulphur, graphene (a) along with EDAX (b) of CuS-G sample.
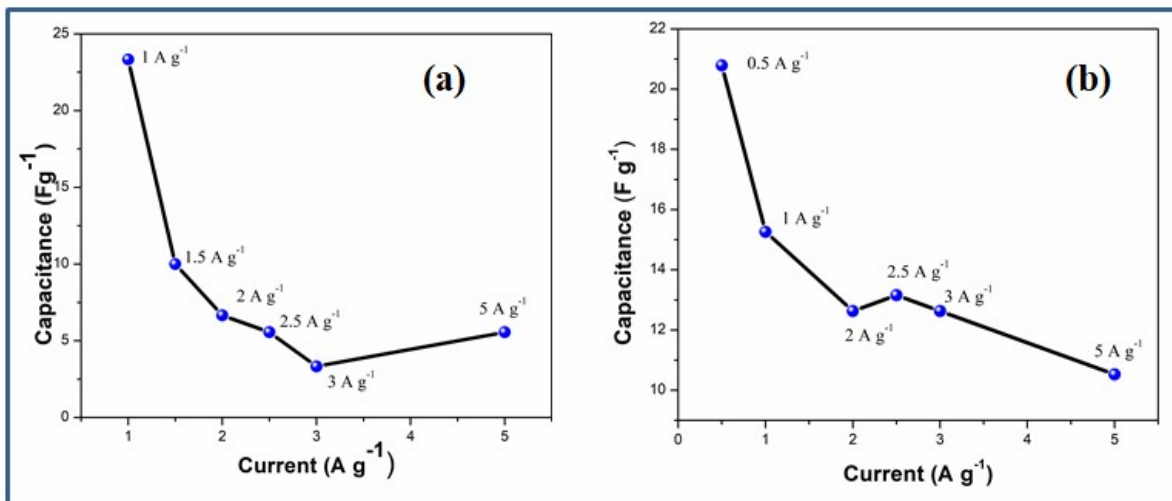
Figure S4 *d*ependence of specific capacitance on the different current densities for CuS (a) and CuS-G (b) electrode.

$$i = a.\upsilon^b \qquad\qquad \textbf{(S1)}$$

$$\log(i) = b.\log(\upsilon)+\log(a) \qquad\qquad \textbf{(S2)}$$

Where, 'i' is the current (mA), 'a' and 'b' are adjustable parameters and υ is the scan rate (mV s^{-1})

Electrochemically active surface area measurement

Electrochemically active surface area (ECSA) of the samples are calculated by double-layer capacitance method by using CV curves. The cyclic voltammograms presented in Figure S5 were collected in the non-faradaic region (for symmetric device) under the potential range of 1.0 to 1.3 V Vs. Ag/Agcl (figure S5a). Where the current is supposed to be due to only double-layer charging. The corresponding plot of current density at a fixed potential of 1.18 V versus the scan rates gives a straight line, the slope of which gives the value of Cdl (Figure S5b). The ECSA is calculated by dividing the Cdl by specific capacitance (Cs).
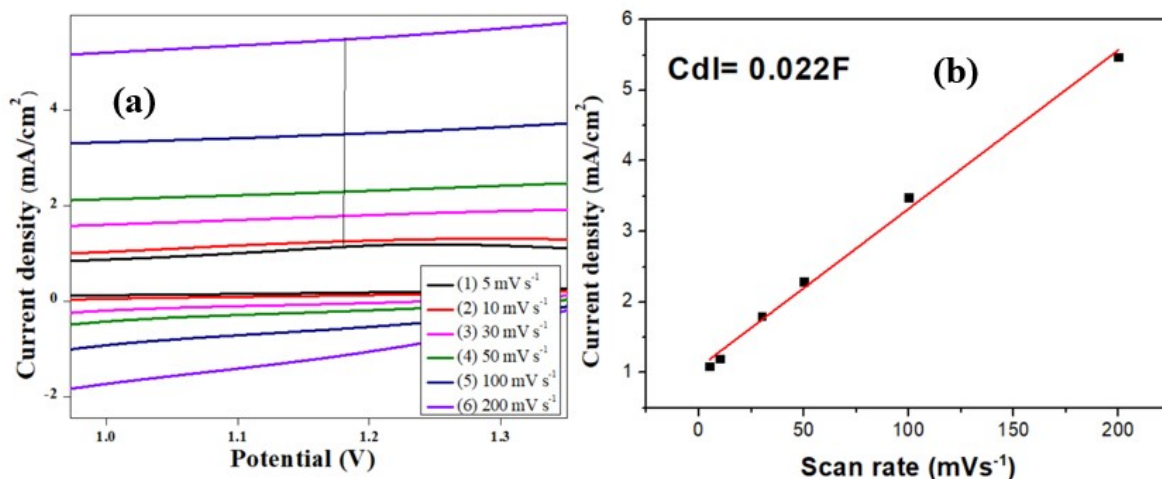
$$ECSA = Cdl/Cs \qquad\qquad \textbf{(S3)}$$

Figure S5 Double layer capacitance measurement to calculate electrochemically active surface area of symmetric device. (A) Representation of cyclic voltammograms in a non-faradaic region. (b) Current measurement at fixed potential of 1.18 V plotted Vs. scan rate.
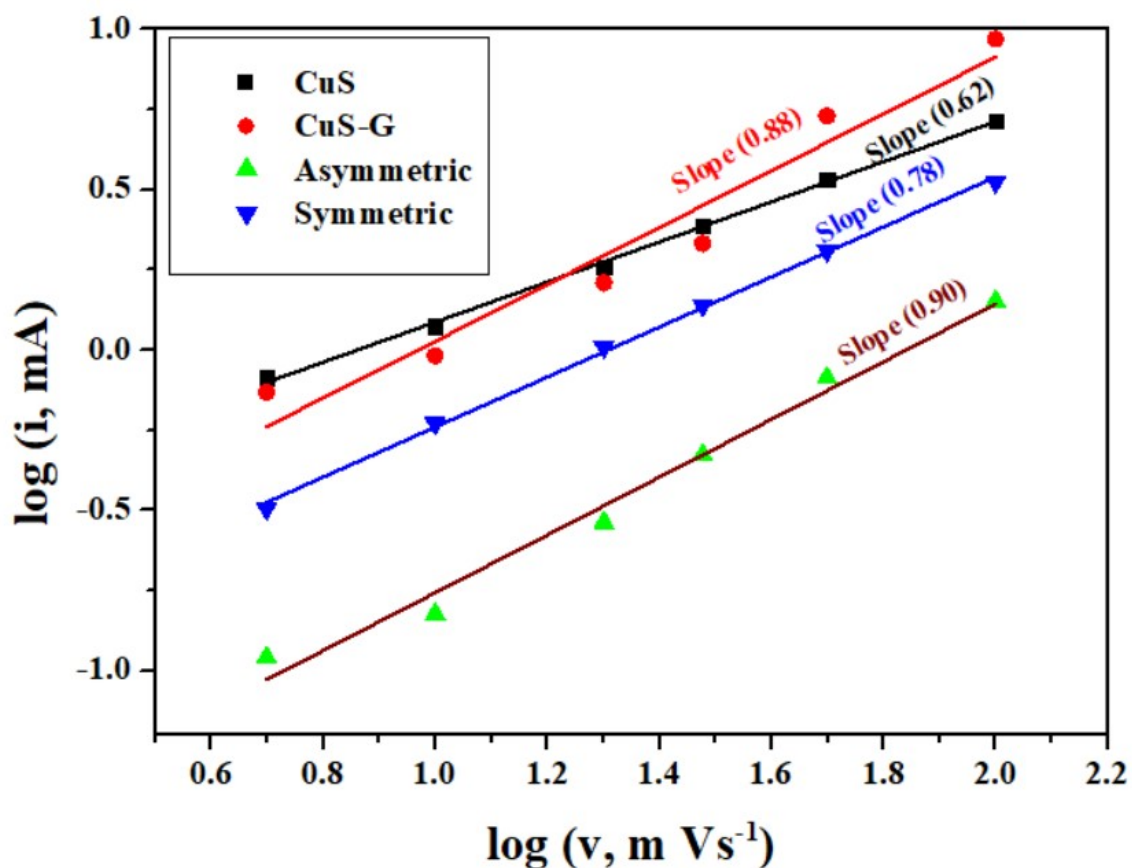

Figure S6 log (i) vs. log (v) plots for CuS, CuS-G, asymmetric device and symmetric device.
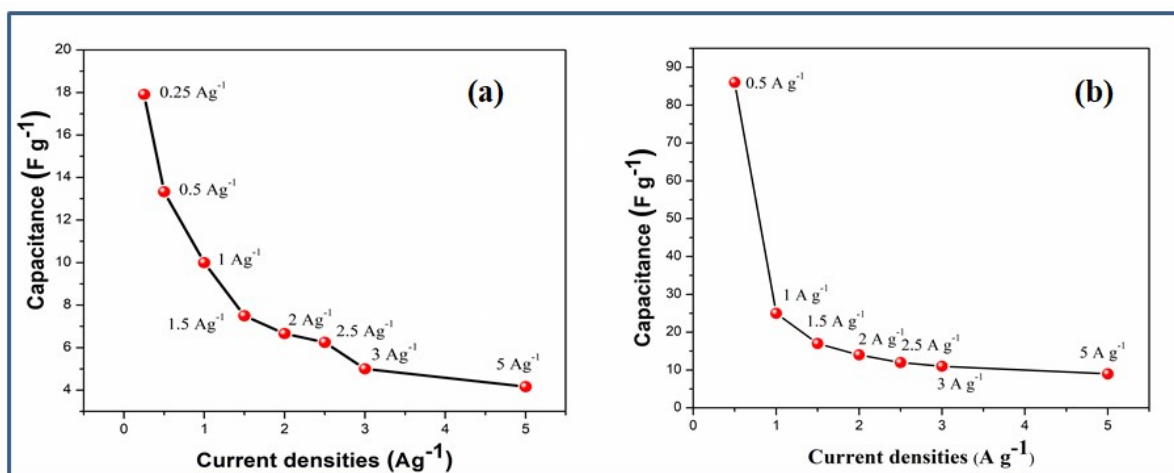
Figure S7 Dependence of specific capacitance on the different current densities for asymmetric (a), symmetric (b) device.