## Single-step microwave mediated synthesis of CoS<sub>2</sub> anode material

## for high rate hybrid supercapacitors

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## **Supporting information**



**Figure S1:** Lithiation of as-prepared conversion-type negative electrode material i.e.,  $CoS_2$  n anoflakes, at a current rate of 1.0 A g<sup>-1</sup>. A fresh cell containing  $CoS_2$  against metallic Lithium in 1M LiPF<sub>6</sub> (EC:DMC, 1:1 by v/v) electrolyte was galvanostatically cycled between 0.3 - 3. 0V. The cell was stabilized for 10 cycles before being used for supercapacitor application. A stable capacity of ~270 mAh g<sup>-1</sup> was obtained after 10 cycles. The cell was stopped after finis hing the discharge of 10<sup>th</sup> cycle and the composite electrode containing sulfide was immediat ely transferred to the hybrid supercapacitor (HSC) cell inside a glove box, thus assembling th e lithiated form of HSC. The HSC was further tested electrochemically for elucidating the eff ect of lithiation. There was no deviation in the specific capacitance of the lithiated form of H SC when the current rate during lithiation was changed.



**Figure S2:** Cyclic voltammograms of (a) non-lithiated  $CoS_2$  and (b) lithium-doped  $CoS_2$  bet ween 0 - 3 V at various scan rates against an AC cathode. Both cells showed typical rectangu lar shaped curves at all scan rates. More importantly, the potential of the lithiated  $CoS_2$  electr ode was higher than that of the corresponding non-lithiated sample, which showed the positiv e effect of lithiation. The lithiated sample had a higher potential, reaching a maximum of 2.2 V, while the non-lithiated sample did not show a rise in potential.





**Figure S3:** (Top) Evaluation of half cells of  $CoS_2$  and activated carbon and optimization of th e mass ratio based on the individual capacity obtained. An optimized mass ratio of 1:3 for AC vs.  $CoS_2$  was achieved and used throughout the study. The voltage of the hybrid supercapacit or  $CoS_2/AC$  was limited to 0-3V for safe operation in order to avoid electrolyte decompositio n. (Bottom) Cycle life characteristics of  $CoS_2/Li$  half cell at 1 mA g<sup>-1</sup> between 0.3 and 3.0V.



**Figure S4:** Cycling curves of hybrid supercapacitors operating at a current rate of 2.7 A  $g^{-1}$  c ontaining non-lithiated and lithiated CoS<sub>2</sub> active materials against the AC cathode.





Figure S5: XPS spectra of as-prepared CoS<sub>2</sub> nanoflakes showing the Co 2p and S 2p bands.

## Calculation for energy and power density:

The specific energy density (ED) and power density (PD) for the cells were determined from charge-discharge studies as follows:

$$PD = IV/2m (W kg^{-1})$$
  
ED = PD x t/3600 (Wh kg^{-1})

where m is the mass of active materials from both electrodes, I the current applied, t the disch arge time and V the cell voltage.