

## Electronic supplementary information<sup>§</sup>

### Probing the electrochemical properties of biopolymer modified EMD nanoflakes through electrodeposition for high performance alkaline battery

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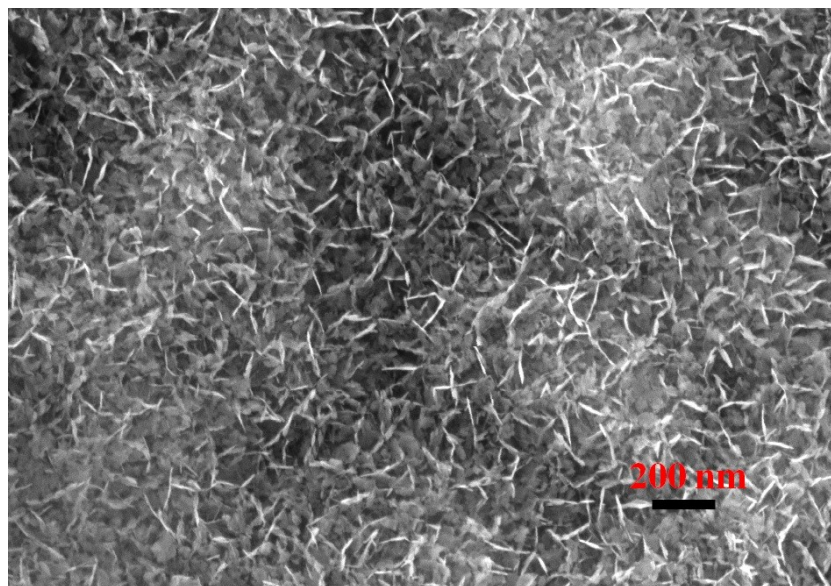
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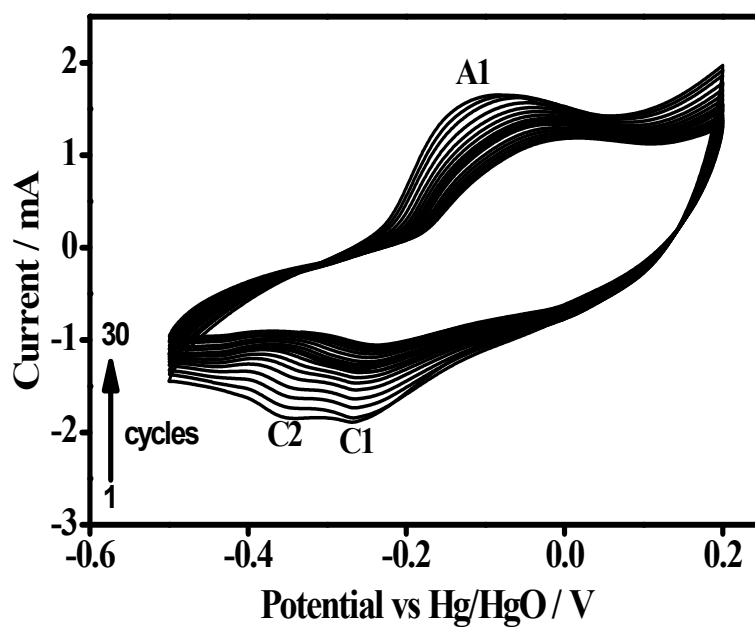
The morphology of polymer modified EMD having a glutaraldehyde concentration of 1.5 % (*termed as “cross-linked EMD<sub>1.5</sub>”*) is shown in Figure S1. It can be observed that the crosslinking process is becoming significant with the higher amount of glutaraldehyde with the initiation of nano petal like morphology.

The cyclic voltammetry (CV) profile for the intermediate concentration of glutaraldehyde (cross-linked EMD<sub>1.5</sub>) is shown in Figure S2. The voltammetric scan was initially started in the cathodic direction (reduction) at 0.2 V until -0.5 V and then reversing back to the starting potential in the anodic direction (oxidation). The profile exhibits cathodic (C1, C2) peaks at -0.26 and -0.35 V respectively and anodic peak (A1) at -0.08 V. The peaks C1 and A1 corresponds to Mn<sup>4+</sup>/Mn<sup>3+</sup> [1] for all the scans while a separate experiment has done to reveal the nature of C2 peak and the results are shown in Fig. S3.

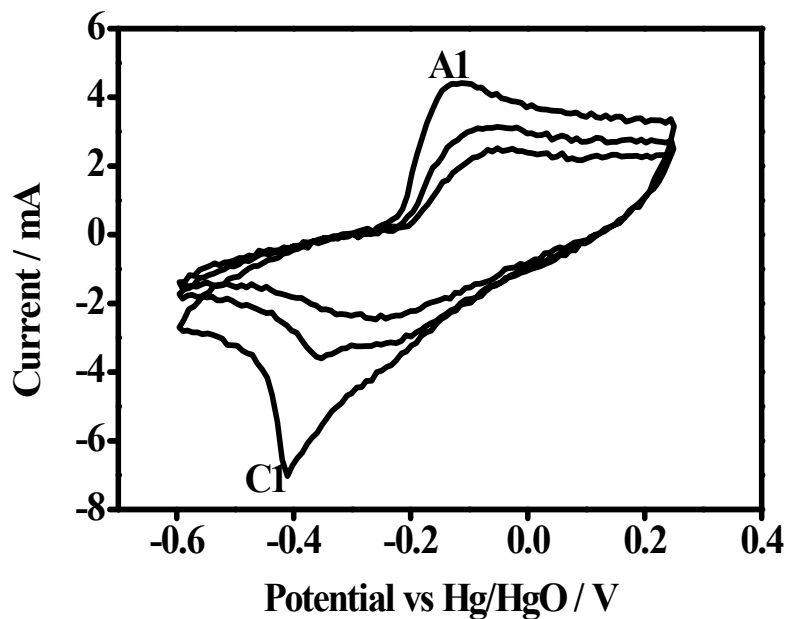
Figure S3 shows the role of carbon in the CV profile when the carbon has been added intentionally to the electrolytic bath prior starting the experiment. The electrodeposited EMD/C composite has been subjected to continuous cycling (20 cycles) in the potential region + 0.2 to - 0.6 V. As can be seen from the figure, cathodic (C1 = - 0.4 V) and corresponding anodic (A1 = - 0.11 V) peaks are prominent. However, during cycling, the cathodic and anodic peak currents decreased significantly suggesting that the material is not reversible. The C1 peak corresponds to carbon and A1 is an oxidised form. Correlating this behavior with the polymer modified EMD samples, in Fig. 6d (main article) and Fig. S2, the location of the C2 peak occurring in this potential region could be assigned to the presence of functional carbon group on the EMD surface.



**Figure S1** FESEM image of cross-linked EMD<sub>1.5</sub>



**Figure S2** Cyclic voltammetry (CV) plot of cross-linked EMD<sub>1.5</sub> at a scan rate of 0.15 mV s<sup>-1</sup> showing the presence of carbon peak (C2).



**Figure S3** Cyclic voltammetry (CV) plot of EMD in presence of carbon in the bath at a scan rate of  $0.15 \text{ mV s}^{-1}$ . The reduction peak (C1) corresponds to a reduction carbon which is irreversible.

#### References

1. M. Minakshi and D. Meyrick, *Electrochim. Acta*, 2013, **101**, 66-70.