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Liquid Electrolyte Mediated Flexible Pouch-type Hybrid Supercapacitor Based on Binder-less Core-Shell Nanostructures Congregated with Honeycomb-like Porous Carbon

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Figure S1. FE-SEM images of bare conductive textile at different magnifications 10 μ m (A), 2 μ m (B), 1 μ m(C) and 200 nm (D). Low magnification images show that uniform fibers are waived together to form textile and high magnification images shows that the surface of the conductive textile are more smooth and polished.



Figure S2. FE-SEM images of Co(OH)₂ grown on conductive textile in10 cyclic voltammetry cycles at different magnifications, 10 μ m (A), 2 μ m (B), 1 μ m(C) and 200 nm (D) It shows that the 10 number of CV cycles makes the Co(OH)₂ seed layer on the surface of the conductive textile. Also, the deposited Co(OH)₂ layer is quite uniform and very thin.



Figure S3. FE-SEM images of Co(OH)₂ grown on conductive textile in 20 number of cyclic voltammetry cycles at different magnifications, 10 μ m (A), 2 μ m (B), 1 μ m(C) and 200 nm (D) It clearly depicts that the formation of Co(OH)2 in sheet-like structure. Also, when increasing the number of CV cycles to 20, the amount Co(OH)₂ nanosheets on the surface of the conductive textile is quite high compared to 10 CV cycles.



Figure S4. FE-SEM images of Co(OH)₂ grown on conductive textile in 30 number of cyclic voltammetry cycles at different magnifications, 10 μ m (A), 2 μ m (B), 1 μ m(C) and 200 nm (D) It clearly confirms that the formation of Co(OH)₂ in sheet-like structure. Also, when increasing the number of CV cycles to 30, the amount Co(OH)₂ nanosheets on the surface of the conductive textile is quite high and controlled growth of the sheet like structure is observed in more uniform and consistent morphology.



Figure S5. FE-SEM images of $Co(OH)_2$ grown on conductive textile in 40 number of cyclic voltammetry cycles at different magnifications, 10 µm (A), 2 µm (B), 1 µm(C) and 200 nm (D) It clearly confirms that the formation of $Co(OH)_2$ in sheet-like structure. Also, when increasing the number of CV cycles to 40, the amount $Co(OH)_2$ nanosheets on the surface of the conductive textile is quite high and controlled growth of the sheet like structure was spoiled due to more number of cobalt ions which clearly suggested that the 30 number of CV cycles is more suitable than others.



Figure S6. FE-SEM images of CoMoO₄ on Co(OH)₂ grown on conductive textile in 180 seconds of chrono-potentiometry technique at different magnifications, 10 μ m (A), 2 μ m (B), 1 μ m(C) and 200 nm (D) It suggested that the formation of CoMoO₄ on Co(OH)₂ nanosheets is very small.



Figure S7. FE-SEM images of CoMoO₄ on Co(OH)₂ grown on conductive textile in 210 seconds of chrono-potentiometry technique at different magnifications at different magnifications, 10 μ m (A), 2 μ m (B), 1 μ m(C) and 200 nm (D) It confirms that the formation of CoMoO₄in the form of small wavy shaped. Also, when increasing the time duration of chrono-potentiometry technique, the growth of CoMoO₄ is also high.



Figure S8. FE-SEM images of CoMoO₄ on Co(OH)₂ grown on conductive textile in 240 seconds of chrono-potentiometry technique at different magnifications, 10 μ m (A), 2 μ m (B), 1 μ m(C) and 200 nm (D) It clearly confirms that the formation of CoMoO₄ on Co(OH)₂ in crumpled sheet-like structure. Also, when increasing the time duration of chrono-potentiometry technique to 240 seconds, the growth of CoMoO₄ is also quite and controlled growth of the crumpled sheet-like structure is observed in more uniform and consistent morphology.



Figure S9. FE-SEM images of CoMoO₄ on Co(OH)₂ grown on conductive textile in 270 seconds of chrono-potentiometry technique at different magnifications, 10 μ m (A), 2 μ m (B), 1 μ m(C) and 200 nm (D) It is observed that the formation of CoMoO₄ on Co(OH)₂ in deformed sheet-like structure. Also, when increasing the time duration of chrono-potentiometry technique to 270 sec, the growth of CoMoO₄ is also quite high and uniform growth was destroyed due to continuous potential scanning which damages the uniform sheet-like structure of Co(OH)₂.



Figure S10. TEM images of $CoMoO_4@Co(OH)_2$ nanosheets on conductive textile at different magnifications (240 sec). The images clearly suggest that the formation crumpled $CoMoO_4$ shell on the $Co(OH)_2$ core. SAED pattern in inset of Figure S10C suggest that the polycrystalline nature of core-shell structure. (D-E) shows the interface between the two structures at the other location.



Figure S11. Photographic images of flexibility of the deposited $CoMoO_4@Co(OH)_2$ on conductive textile at the different bending conditions.



Figure S12. Electrochemical performances of $Co(OH)_2$ on CT at different deposition cycles. Cyclic voltammetry curves at the scan rate of 5 mV s⁻¹ (A), galvanostatic charge discharge curves at current density of 1 mA cm⁻² (B) and areal capacity with respect to different cycles (C) suggesting the higher areal capacity has been achieved at the deposition cycles of 30 cycles.



Figure S13. Galvanostatic charge discharge curves at current density of 2.5 mA cm⁻² (A) and areal capacity with respect to different cycles (B) of CoMoO₄@Co(OH)₂ grown on conductive fabric suggesting the higher areal capacity has been achieved at the deposition time of 240 sec.



Figure S14. Electrochemical performances of CoMoO₄/CT core-shell: Cyclic voltammetry curves at different scan rates (5 to 100 mV s⁻¹) (A) Galvanostatic charge discharge curves at different current density (1 to 25 mA cm⁻²) (B) at the deposition time of 240 sec



Figure S15. Nyquist plot for $Co(OH)_2$ and $CoMoO_4@Co(OH)_2$ grown on conductive fabric. Both the spectra show common features: a small semi-circle at the higher frequency, a second larger capacitive loop at the lower frequency, and a straight line in the middle frequency part related to the diffusion. It can be clearly suggested that both solution and charge transfer resistances are low for $CoMoO_4@Co(OH)_2/CT$ compared to $Co(OH)_2/CT$ which leads to the better conductivity.



Figure S16. Comparison of CoMoO₄/CT, Co(OH)₂/CT and CoMoO₄@Co(OH)₂/CT core-shell: Galvanostatic charge discharge curves (A) and corresponding areal capacity (B) measured at 1 mAcm⁻² current density



Figure S17. (A) N₂ adsorption/desorption isotherm, (B) Pore size distribution curves of prepared lab waste tissue paper derived activated carbon.

| Source material | Textural Properties | | | Electrochemical Properties | | Ref |
|--|------------------------|-----------------------------------|----------------------|-------------------------------|---------------------|--------------|
| | | | | | | |
| | | [m ² g ⁻¹] | [ccg ⁻¹] | D [A] | [Fg ⁻¹] | (cycles) [%] |
| Tea leaves | 2841 | 1.366 | | 330 | 92 (2000) | [1] |
| Tree bark | 1018 | 0.67 | - | 191 | 100 (5000) | [2] |
| Floor food waste | 1834 | 0.92 | - | 278 | 95 (3000) | [3] |
| Cattail | 442 | 0.33 | - | 126.5 | - | [4] |
| Banana fibers | 1097 | - | 23 | 74 | 88 (500) | [5] |
| Potato waste (N ₂ doped) | 1052 | 0.61 | 2.33 | 255 | 93 (5000) | [6] |
| Cow dung | 1984 | 0.38 | - | 124 | - | [7] |
| Silica template | 1957 | 3.0 | - | 157 | ~96 (2000) | [8] |
| Lab waste tissue paper | 1971 | 0.98 | 3.68 | 227 | 100 (2000) | This work |

 Table: 1 – Textural and electrochemical properties of prepared activated carbon with previous

 reports

S_{BET} – Surface area; V – Pore volume; D – Pore diameter; Csp – Specific capacitance

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