Supplementary Information for

Waste Polyethylene terephthalate plastic derived Zn-MOF for high performance supercapacitor application

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## S-1 Characterization

  The crystallinity and phase of MOF-5 were determined using Powder X-ray diffraction (PXRD) with a Rigaku diffractometer (PXRD, D-Max 2550 VB-PC). The microstructures were examined using a scanning electron microscope JSM-6380 LA instrument (JEOL, Japan) equipped with an energy-dispersive X-ray functionality and transmission electron microscope (TEM) to investigate the surface morphology. Fourier Transform Infrared Spectrometer (FTIR) was utilized to characterize the spectra, and the Tensor 27 FTIR spectrophotometer (Bruker, Germany) and a potassium bromide disk technique were used to analyze the samples within the range of 400 to 4000 cm-1. X-ray photoelectron spectroscopy (XPS) with monochromatic Al Kα (ESCALAB 250Xi, Thermo Fisher Scientific, America) was employed to explore the surface states of the products. The study employed a TG/DTA machine (TA-Q500 system, TA, USA) to conduct thermogravimetric analysis under a nitrogen atmosphere. The heating rate was set at 10 °C min-1, and the desired temperature was 800 °C. The surface area analysis of the materials was carried out using a BET physisorption analyzer (Micromeritics, ASAP-2020, USA) at a temperature of 77 K in liquid nitrogen. Furthermore, the study analyzed the Brunauer-Emmett-Teller (BET), Barrett-Joyner-Halenda (BJH), and Dubinin-Astakhov (DA) pore size distribution of the materials.

## S 1.1 Electrochemical studies

Detailed electrochemical analysis of the produce Zn-MOF materials was performed on CHI-660E potentiostat in 6 Molar KOH electrolyte. The Working electrode was made through making a slurry of active materials (90 wt%), PVDF binder (5 wt%), carbon black (5 wt%), few drops of N-Methyl pyrrolidone and pasted on glassy carbon electrode used as a current collector, platinum wire as counter electrode, Ag/AgCl as reference electrodes respectively. Electrochemical supercapacitor calculations i.e. the capacitance gravimetric (Cg) was estimated using cyclic voltammetry (CV) through following equation:

Where gravimetric capacitance is denoted with “Cg” (F g−1), scan rate is represented as ‘s’, potential window referred as ‘V’, the discharging part of the cyclic voltammograms expressed through the integration of I(V) dV and mass of electrode materials is symbolized as ‘m’.

“Cs” is the specific capacitance was computed from the GCD curves by following equation:

Where, applied charge discharge current at a discharge time Δt (s) is denoted by “I”, dropout voltage by ΔV, and mass of working materials expressed with “m”.