ABSTRACT

The increasing world energy crisis necessitates tracing of effective, sustainable, and long term storage energy technologies. A metal-organic framework (Cu-PTA-MOF) based on copper was prepared through a pyridine-2,4,6-tricarboxylic acid organic linker in this paper through a sonication synthesis pathway. This material which was ready-to-use was once more altered in the addition of multiwalled carbon nanotubes (MCNTs) in order to improve conductivity and structural stability. X-ray diffraction (XRD) structural confirmation and Fourier-transform infrared spectroscopy (FTIR) was performed to establish that coordination of Cu(II) with PTA ligands was successful. Electrochemical analysis was done in three-electrode and two-electrode systems, i.e. cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS). Cu-PTA-MOF@MCNT composite showed a better redox activity, specific capacity of 20.592 C/g at 1.5 A/g, cycling stability of 110 % for 10,000 cycles along with energy density Es and power density Ps of 7.321 Wh/kg and 1256.88 W/kg correspondingly in the hybrid supercapacitor assembly with activated carbon as the counter electrode. Cu-MOF pristine had lower kinetics of charge transfer and specific capacitance than the CNT composite. Moreover, Zn-ion battery mode was also used with the Cu-PTA-MOF@MCNT, it exhibited a stable cycling exhibit efficiency of 100 % for 1000 cycles, specific capacity of 2.935 C/g at 0.1 A/g, along with energy density Es and power density Ps of 3.026 Wh/kg and 189.59 correspondingly and excellent reversibility because of synergistic pseudocapacitative and faradaic reactions. Cu-PTA-MOF@MCNT showed better results in hybrid supercapacitor assembly compared to Zinc-ion battery. The findings demonstrate the opportunities of Cu-PTA-MOF and its composites as high-performance electrode materials of supercapacitors of the next generation and zinc-ion batteries with high performance, to provide the practical application with the balance of energy density and power density.