ABSTRACT

A sustainable, long run, multipurpose energy storage device with lucrative properties of energy and power output is highly desirable in portable electronic application. From the growing anxiety of depletion of fossil fuel, the simultaneous concern of inauguration of energy harvesting and energy storage devices from renewable energy sources, are persuited thereby. Supercapacitor shares few benefits like fast charging ability, high power output, long cycle life, flexibility and wide temperature applicability which are desirable in modern portable electrical industry, but they reveal deficient energy density, lower voltage window. Our present work focuses on accomplishment of higher energy density and voltage window along with cycle life and power supply. Our study on $MnCo_2O_{4.5}$ though suffered from low specific capacitance and small range voltage window. However, the cumulative faradaic output from $MnCo_2O_{4.5}$-$NiCo_2O_4$ hybrid material established the efficacy of synergy, nanoarchitecture and surface property of materials in preparing the supercapacitor electrode material and thus compensates the drawbacks. The work on iron oxide doped reduced graphene oxide (Fe-rGO) delivered impressive capacitive output along with pseudocapacitive traces. Cupper-nickel-cerium-cobalt (Cu-Ni-Ce-Co) oxide was exploited as superior mixed metal oxide when tuning the composition from mono metallic to quaternary oxide and prompted to show a superior specific capacitance with commendable performance in terms of high energy and power density. Moreover, our work on zinc vanadium oxide battery material opens up its credibility as supercapacitor electrode material. With conducting polymer, it extended the operating voltage window and exposed a good power density. Again, the introduction of cobalt tin hydroxide @ nickel hydroxide (CTH@NH) core-shell assembly was found to improve energy density abruptly while maintaining good power density and cycle life. The double walled morphology of CTH is a unique feature which improves the wettability of electrode material. Lastly, the work based on metal organic framework (MOF) derived metal oxides are well known for their methodical approach of synthesis process. They are having remarkable porosity which leads to greater surface area and ordered morphology along with good thermal and chemical stability. The benefits of fine tuning of the size and structure of the MOF enhances their electrochemical capability and hence 2-methyl imidazole derived cobalt nickel oxides exhibited superior energy density with enduring cycle stability. The aforementioned electrode materials are very much pertinent in constructing flexible and lightweight asymmetric supercapacitor cells (ASC). These nanostructured, high-performance materials-based ASC devices validate their suitability in

practical application and hence hopefully can bridge the void gap between batteries and conventional capacitors.

KEYWORDS: Supercapacitor, voltage window, energy density, power density, cycle stability.