

## ABSTRACT

Hybrid supercapacitors, which combine the qualities of batteries and supercapacitors, are being developed to meet the demands of the modern era. Metal-Organic Frameworks (MOFs), with their huge surface area, low density and high porosity, emerge as auspicious contenders for applications in electrocatalysis, batteries, capacitors, and super-capacitors. This thesis delves into the synthesis methods and electrochemical performance of Cobalt-based Heterobimetallic MOFs, specifically the Co/Zn@BMOF, Co/Ni@BMOF, and its composites with rGO, highlighting their potential in super-capacitor applications. They were synthesized using a sonochemical approach. A variety of characterization techniques (FTIR, XRD, TGA, Electrochemical characterization) were employed to analyze the synthesized MOFs. It is presented here that composites of Co/Ni@BMOF i.e, Co/Ni@BMOF/rGO ( Z-25%/Z1, Z-50%/Z2 and Z-75%/Z3) have been synthesized. Three electrode assemblies were tested using 6M KOH for their electrochemical characteristics. Co/Ni@BMOF/rGO-25% (Z-25%/Z1) showed promising results. In practical applications, the hybrid supercapacitor is connected to an activated carbon electrode. Dunn's method has been used to analyze the capacitive-diffusive contributions of the hybrid supercapacitor. The material showed high specific capacity of 782.08 F/g at 3 A/g current density, energy density of 35 W h/kg and power density of 3500 W/kg. It showed 100 % efficiency even after 5000 GCD cycles. As, Co/Ni@BMOF/rGO-25% (Z-25%) showed high power density, energy density as well as extraordinary stability making it a promising candidate for future hybrid supercapacitors.