



ABSTRACT

This dissertation documents six different projects that have been completed ranging from rational synthesis and characterization of the MOFs to their utilization in a number of electronic devices. In project 1, a reticular multifactor-driven self-assembly process was demonstrated between a C_6O_6 type ligand and Cu ions to selectively produce three CPs with distinct 2D topologies of **hcb**, **hxl**, and **kgd**. The interplay of deprotonation, redox reaction, and coordination events between the constituents chiefly determined their connectivity and oxidation states in the resulting CPs, which is in contrast with those where the topology is predominantly controlled by the mode of coordination of the building units. In project 2, three 2D $d\pi$ isorecticular MOFs i.e., Cu_3HHB_2 , Cu_3HHTP_2 , Cu_3HHTN_2 were chosen to explore their proton and single ion (Li^+ , Mg^{2+}) conduction potential. All the mofs shared the same **hcb** topology *mofs* but differ in porosity. All the isorecticular mofs failed to show any impressive proton conductivity. Later the same MOFs were impregnated with the chloride salts of Lithium and Magnesium and their ionic conductivity potential was gauged by electrochemical impedance spectroscopy. The findings revealed that ionic conductivity is independent of MOF topology and porosity rather it entirely depends upon %age metal loading and inner pore milieu. In project 3, Three isostructural lanthanide coordination polymers (CPs) with the formula $C_3H_3LnO_6$ [$Ln = Pr(1), Ce(2), \text{ and } Dy(3)$] were solvothermally synthesized by self-assembly of lanthanide (III) and *in-situ* generated methanoic acid by the hydrolysis of *N,N*-Dimethyl formamide. These CPs were characterized by FTIR, Elemental analysis, PXRD, and single crystal analysis and their photocatalytic and chemosensing applications were explored. In Project 4, a 2D cobalt-PDA metal organic framework was solvothermally synthesized and characterized by single crystal XRD, SEM and BET. The surface type Au/Co-PDA/Au humidity sensor was devised and the effects of changing relative humidity on the electrical parameters (capacitance and resistance) and their multi frequency response was measured. A remarkable increase in capacitance and decrease in resistance were observed during the rise of relative humidity from 45% to 95% RH.

The project 5 described the conversion of zero-valent copper metal to conductive two-dimensional (2D) bimetallic Nickel phthalocyanine based metal-organic framework



(NiPc-Cu-O). This novel method enables patterning of MOF onto a variety of flexible and porous substrates (cotton, silk, weigh paper, filter paper, nylon, Nyco, army fabric, cotton pant and polyester) with high resolution (500 μm) and no specialized equipment. This method produces electronic textiles with sheet resistances of 0.02–30 $\text{M}\Omega/\text{cm}^2$ and uniform conformal coatings of MOF on textile swatches with strong interfacial contact capable of withstanding chemical and physical stresses. The project 6 explored the electrocatalytic applications of 2D bimetallic Nickel pthalocyanine based copper MOF (NiPc-Cu-O) against CO_2 reduction. The performance of working electrode was compared by fabricating it with the conventional nafion-carbon black methodology and newly devised oxidative restructuring methodology that allowed the direct fabrication of the MOF over carbon fiber substrate. This study is first of its kind where MOF based electrocatalyst is directly grown on a conductive substrate without any binder or additive.

Key words: Coordination polymers, metal organic frameworks, Ionic Conductivity, Chemosensing, Photocatalyst, Humidity sensor, Oxidative restructuring, CO_2 reduction