

ABSTRACT

This dissertation demonstrated synthesis, characterization and evaluation of fluorescence and electrochemical applications of nine coordination complexes. Zn(II) 2D coordination complex, $\text{RhB}[\text{Zn}(4\text{-bromoisoi})_2(1,10\text{-Phen})\cdot\text{H}_2\text{O}]_n$ (CC1), Zn(II) 2D coordination complex $\text{RhB}[\text{Zn}(4,4\text{-bipy})(\text{TMA})]$ (CC2), Ag(I) 2D coordination polymer $[\text{Ag}_2(3,4\text{-Pydc})_2]$ (CC3), Co(II) 3D coordination complex $[\text{Co}_7(2,6\text{-Pydc})_8\cdot 12\cdot\text{H}_2\text{O}]\cdot 7\text{H}_2\text{O}$ ($\text{C}_{112}\text{H}_{130}\text{Co}_{13}\text{N}_{16}\text{O}_{102}$) (CC4), Cu(II) 2D coordination complex ($\text{C}_{108}\text{H}_{114}\text{Cu}_3\text{N}_{12}\text{O}_{60}\text{S}_6$) (CC5), $\text{CR}[\text{Ni}(\text{TMA})(4\text{-bromoisoi})\cdot\text{H}_2\text{O}]$ (CC6), Cu(II) 2D coordination complex $[\text{Cu}(2,6\text{-Pydc})_2]$ (CC7), Schiff base chemosensor 3,5-bis(((2-hydroxynaphthalen-1-yl)methylene)amino) benzoic acid (3,5-BHNABA) (CC8) and Hg(II) 2D coordination complex $[\text{Hg}(\text{TMA})_2]$ (CC9). CC1, CC2, CC4, CC5, CC6 and CC9 complexes were synthesized by sonication while CC3, CC7 and CC8 were synthesized by the reflux method. These coordination complexes were analyzed by single-crystal and powder X-Ray diffraction, elemental analysis, TGA, FTIR and UV-Visible spectroscopy. They were further tested for fluorescence and electrochemical applications. Encapsulation of Rhodamine B dye was conducted in CC1 and its fluorescence characteristics demonstrated that CC1 behaved as an active sensor for Cr(VI) . CC2 also contained a dye composite of zinc MOF. The percentage quenching results of CC2 illustrated that it may be employed for the detection of selective of chemosensing of 4-nitrophenol. Crystal-structure and DFT computation was carried out for silver (I) complex CC3. Electrochemical applications through evaluation of CV, GCD and EIS were carried out and discussed for specific capacitance, energy density, power density and cyclic stability. For CC4 an electrochemical study was performed on the cobalt coordination complex. Fabrication of a battery device, consisting of CC4 with activated carbon (AC) as electrode demonstrated specific capacitance 118.5 Fg^{-1} , energy density 5.92 Whkg^{-1} and power density 90.0 Wkg^{-1} . Redox active material $\text{K}_4[\text{Fe}(\text{CN})_6]$ was added in the 1M KOH electrolyte which increased electrochemical performance of CC4. It exhibited specific capacitance 61.2 Fg^{-1} , energy density 26.29 Wh kg^{-1} and power density 883 W kg^{-1} . The cyclic stability was determined as 94.2 % by 3000 cycles of charge-discharge at current density of 8 Ag^{-1} . Based on the preliminary inspiring results of electrochemical analysis, the CC4 qualified as a promising candidate for efficient electrode material for ultra-modern reserves of energy application. CC5 resulted as new Cu(II) based MOF utilizing 5-sulfoisophthalic acid sodium salt as ligand. It showed an excellent electrochemical property to be utilized as a good energy storage device. Electrochemical studies

showed an excellent electrochemical property to be utilized as a good energy storage device. Electrochemical studies through measurement of CV, GCD, EIS, good cyclic stability at 5000 cycles and energy density of 50 Whkg^{-1} and power density 1875 Wkg^{-1} demonstrated its capacity for energy storage. Moreover, the capacitive-diffusive nature of the super capacitor was determined by the Power law and Dunn's method. Electrochemical measurements of CC5 justified its behavior as battery type electrode material. CC6 demonstrated congo red dye Ni-MOF. Fluorescence applications elaborated its ability to act as a calibrating sensor for selective sensing of nitroaromatics specially picric acid as well as sensitive probing of Cr(III) and Cr(VI). Quenching efficiency gave insight in to the sensitivity and selectivity of CC6 towards selective nitroaromatics. Detection of copper is very vital nowadays. There is an acute need to remove the impurities especially heavy metals from water. CC7 demonstrated the detection of copper from aqueous media using 2,6-pyridinedicarboxylic acid by fluorescence turn-off. Selective fluorimetric detection of Cu (II) was monitored by using 2,6-pyridinedicarboxylic acid. It was observed that probe 2,6-pyridinedicarboxylic acid showed florescence quenching behavior and it was highly selective and sensitive towards the detection of Cu (II) ions with limit of detection of 3.6 uM . CC8 showed a turn-off response for Cu^{2+} and Ce^{4+} ions. Different analytical parameters such as limit of detection (LOD), limit of quantification (LOQ), Stern-Volmer constant and stoichiometry ratio were studied and it was found that the ligand served as an efficient tool for detection of Cu^{2+} and Ce^{4+} ions in aqueous medium. CC9 a complex of mercury derived from carboxylate ligand, revealed cellular interaction through atomic force microscopy and live/dead cell assay.