

This dissertation documents synthesis of seven coordination polymers which have been evaluated for their photoluminescence applications. Zinc (II) 2D polymer,  $[Zn(3,5-Pydc)_{0.5} \cdot H_2O]_n$  (CP1), Ni (II) 2D polymer  $[Ni(3,5-Pydc)_1 \cdot (H_2O)_3] \cdot 2H_2O$  (CP2), Cu(II) 3D polymers  $[Cu(3,5-Pydc)_1 \cdot (H_2O)_2]_n$  (CP3),  $[Cu_2(1,2,4,5-Btc)_2] \cdot (H_2O)_2 \cdot (MIZ)$  (CP4), and Gd (III) 2D polymer  $[Gd_2(3,5-Pydc)_3 \cdot (H_2O)_3 \cdot CHO_2 \cdot C_3H_7NO] \cdot 2H_2O$  (CP5) 3,5-Pydc = Pyridine-3,5-dicarboxylate anion, 1,2,4,5-Btc = Benzene-1,2,4,5-tetracarboxylic acid, MIZ= 2-methylimidazole} has been prepared under sonication conditions and characterized by elemental analysis, FTIR spectroscopy, thermal analysis and single-crystal X-ray diffraction. Cu (II) (CP6) and Ni (II) (CP7) complexes of bezotriazole-5-carboxylic acid has been synthesized through solvothermal process and structural evaluation was carried out through FTIR spectroscopy, powder X-ray diffraction analysis and thermal studies. The metal-based luminescence properties of all coordination polymers have been evaluated and results revealed that CP1 can be used as selective chemosensor against 4-nitroaniline. The CP1 showed the excellent quenching efficiency of 98.9%. Density functional theory (DFT) simulations complement to the specific luminescence quenching of CP1 against 4-nitroaniline. CP2 having octahedral coordination geometry exhibits maximum emission intensity in ethylacetate, possessing greater sensitivity for 4-nitroaniline in accordance with CP1 with the  $K_{SV}$  value of  $1.19 \times 10^4 M^{-1}$ . In contrast CP3 exhibiting monoclinic crystal system produced distinguished results by showing 83% quenching efficiency for 4-nitroaniline and 98% quenching efficiency for 4-nitrophenol. This multi-responsive CP3 displayed hypsochromic shift against 4-nitroaniline and bathochromic shift against 4-nitrophenol by applying series of dilutions of the respective quenchers, which is in accordance with the respective HOMO and LUMO energy gaps. Additionally, CP4 possessing 2-methylimidazole (heterocyclic co-ligand) a 3D coordination polymer exhibits excellent luminescence property in ethylacetate solvent system with the maximum emission at 285 nm along with lower peaks at 528 nm and 566 nm. Percent quenching order of CP4 against various NACs has been as follows 4-NA < 2-NA < 4-NT < 4-NP < picric acid, with the maximum of 89.96% for picric acid with the  $K_{SV}$  value of  $5.5 \times 10^3 M^{-1}$ . Additionally, CP5 possessing tricapped trigonal prismatic geometry around  $Gd^{3+}$  supports the fast and associative exchange of hydronium ions thereby displays a promising luminescent application for the sensing of pH. This gadolinium metal based complex showed an antenna effect at 380 nm with the significant red shift in n-butanol solvent system from that of free ligand. A hypsochromic shift is observed with the increase in pH from 3.5-5.5 along with reduction in intensity and by increasing pH >6.77 emission achieves negative value (luminescence turn off) and by lowering the pH <5.21 emission intensity gains positive value (luminescence turn on) exhibiting pH triggered optical switch. It has been observed that CP6 did not show appreciable fluorescence results but in contrast CP7 possessing face centered cubic structure having particle size 48.08 nm and strain 'e'  $3.06 \times 10^{-3}$ , was evaluated for chemical stability through luminescence studies by varying pH of the solution. It has been revealed that CP7 is a stable compound which regains its luminescent properties in the range of pH 6.84-7.41 concomitantly possessing highest stability in DMF solvent.