Abstract and Keywords

Syntheses of heterometallic complexes have drawn the attention of the chemist for their applications in the field of catalysis, magnetism, and sorption. In addition, the heterobimetallic or heterotrimetallic complexes afford structural diversity such as helical chains, metal clusters, coordination polymers, metal-organic frameworks (MOFs). But, Synthesis of heterometallic complexes remains a challenge due to the homometallic complex formation. There have been many ways to synthesize the heteromultimetallic compounds, but metalloligand strategy is the best among all. Metalloligand is a metal complex that can bind other metal ions using its appended functional group(s). Applying this method, we can diminish the chances of formation of homometallic complexes and one can get exclusively heterometallic compounds. The design and synthesis of heterometallic polynuclear compounds via metalloligand approach have received intense attention over the past few years. A survey of the literature reveals that mainly transition metal complexes like those of iron, cobalt, nickel, ruthenium, and copper have been used as metalloligands. Polyoxomolybdates have been found to bind other metal ions through the oxo-ligand and form heteropolymolybdates. However, mononuclear or dinuclear oxo molybdenum and oxo vanadium complexes containing organic ligands acting as metalloligands have rarely been explored.

Thus in this dissertation, the results of a systematic approach towards the use of dioxo molybdenum and oxo vanadium complexes as metalloligands for the synthesis of heterobimetallic and heterotrimetallic polynuclear compounds have been described. The metalloligand, $[L^1MoO_2(\mu\text{-}O)MoO_2L^1]^{2-}$ {H_2L^1 = 2-(3-tert-butyl-2-hydroxy-5-methoxybenzylamino) acetic acid} and $[L^2V(O)(\mu\text{-}O)V(O)L^2]^{3-/4-}$ { H_3L^2 = nitrilotriacetic acid} and their complexes with s-block, transition metal ions, and cerium have been synthesized and structurally characterized by single crystal X-ray diffraction. The heterobimetallic complexes of s-block metal ions (e.g. Mg^{2+}, Ca^{2+}, Sr^{2+}, and Ba^{2+}) and transition metal ions (e.g. Co^{2+}, Ni^{2+}, and Zn^{2+}) have been found to be single source precursors for the synthesis of mixed metal oxides. The mixed metal oxides of the type $MMoO_4{\cdot}MoO_3$ (M = Mg^{2+}, Ca^{2+}, Sr^{2+}, and Ba^{2+}) are good gas sorption and selective dye sorption materials. The heterotrimetallic complexes of molybdenum metalloligand and s-block metal ions (Na^+, K^+, Rb^+, and Cs^+) are showing dye adsorption properties. The heterobimetallic and heterotrimetallic complexes of vanadium metalloligand with [Co^{2+}, K^+], [Cu^{2+}, K^+], and [Ce^{3+}] are exhibiting interesting magnetic and luminescence properties, respectively. The heterotrimetallic complex of Co^{2+} exhibits slow relaxation of magnetization.

Keywords: Molybdenum, Vanadium, Cerium, s-block metal ion, Transition metal, Metalloligand, Heterobimetallic, Heterotrimetallic, Cluster, Coordination polymer, Mixed metal oxide, Dye, Adsorption, Magnetic properties, Luminescence properties.