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Abstract

The main focus of this thesis is on development of various sorbent materials and their modifications for the removal of some of the toxic species from water. ZnO nanoparticles with tailored surface charge were prepared by changing the synthesis protocols. In order to overcome their poor stability in acidic conditions and to facilitate the selective removal of toxic ions, ZnO-composite nanoparticles were also designed. Thiol surface modified ZnO NPs were shown to be highly effective and selective sorbent materials especially for Hg(II) and Pb(II). In order to prepare new sorbents with far superior chemical stability, the synthesis of Mo substituted CeVO₄ nanoparticle by a simple co-precipitation synthesis was carried out. These samples showed high sorption capability towards Pb(II) ions. In continuation, magnetic nano-sorbents like Fe₃O₄-SiO₂ (SMNPs) were also prepared and their potential for separation of transition metal ions and cationic dyes like methylene blue was established. Mo-doped TiO₂ samples were also prepared, characterized by various techniques and were evaluated for photo-chemical degradation of organic dyes.

In the second part of the thesis magnetic nanoparticles were prepared and explored as theranostic materials for cancer therapy. The strategy to improve the efficacy of the magnetic nanoparticles (MNPs) by optimization of the surface coating thickness using biocompatible moiety silica (SiO₂), for hyperthermia treatment has been discussed. Biocompatibility of the MNPs is evaluated invitro by assessing their cytotoxicity and hyperthermic killing ability was also evaluated in HeLa cells using the same method. The water dispersibility and drug conjugation efficiency of the magnetite nanoparticles were done by coating it with sodium tri polyphosphate, thus rendering it more biocompatible. The thesis led to several publications in reputed journals.