Abstract

Magnetic nanomaterials have consistently been receiving considerable amount of attention due to their wide range of applications. Metallic nanoparticles, e.g. Fe, Co, Ni exhibit larger magnetization compared to corresponding metallic oxides making them interesting for many applications. The magnetic properties as well as applications of these ferromagnetic nanomaterials are strongly sensitive to the morphology, crystallinity, magnetization direction. The present work is focused on the synthesis of elemental ferromagnetic nanomaterials and their characterization followed by their applications in the field of environmental remediation in removal of biological/chemical contaminants and absorption of electromagnetic radiations, which may be outlined as follow:

Ag catalyzed growth of Co microflowers and Ni nanoflowers has been carried out in presence of different capping agents by the hydrazine hydrate mediated reduction of corresponding metal salts and characterized. It has been established that Ni nanoflowers are composed of cone like petals and acted as efficient microwave absorber. On the contrary, Co microflowers composed of nanoflakes have been used as a catalyst in room temperature reduction of the toxic organic pollutant *p*-nitrophenol.

The prickly nickel nanowire has been fabricated by hydrazine hydrate mediated reduction of nickel chloride hexahydrate in microemulsion medium at 70 °C. Subsequently, its surface has been modified by silver using Tollen's reagent to form Ni/Ag nanostructure and characterized. Ni/Ag exhibited excellent catalytic activity for the room temperature reduction of *p*-nitrophenol. It also exhibits better antibacterial activity compared to the commercially available antibacterial agent.

Stepped hexagonal Ni/ZnO nanostructures have been successfully prepared by hydrazine hydrate mediated reduction of nickel chloride at 140 °C under solvothermal condition followed by refluxing. Subsequently, it has been used as a catalyst for the photocatalytic degradation of organic dye methylene blue under ultraviolet light irradiation. These Ni/ZnO nanostructures can be easily separated by magnetic separation and reused upto five cycles with a slight loss of activity.

Nickel/polypyrrole (Ni/PPy) nanostructures have been synthesised via an *in situ* oxidative polymerization of pyrrole monomer in presence of $FeCl_3$ oxidant in an aqueous suspension of Ni nanoflowers at room temperature and characterized. It acts as an efficient adsorbent in the removal of As(III) and F^- from contaminated water. The influences of the parameters, such as adsorbent dose, pH, contact time and coexisting anions on the adsorption efficiency have also been studied. The used Ni/PPy adsorbent could be easily regenerated by treating it with acid/alkali and also easily separated from the reaction mixture by the application of an external magnetic field and reused.

Finally, Ag encapsulated $Fe@SiO_2$ nanostructures have been successfully prepared on depositing SiO_2 and Ag on already synthesized Fe nanorods using Stöber method and silver mirror reactions respectively. This nanostructure has been employed for absorbing harmful microwave irradiation and detection of carcinogenic dye crystal violet.

Key words: Fe, Co, Ni, Nanomaterials, Environmental remediation, Photocatalysis, Electromagnetic.