Abstract

This thesis covers two topics of latest research in the field of nanotechnology. One topic covers the development of nanomaterials for spintronic devices and the other one is about degradation of organic dye using various semiconductor photocatalysts. The aim of thesis is to investigate and explore the physics behind TM on different applications in the field of spintronics and photocatalysis. The role of rare earth, Gadolinium (Gd) concentration on magnetization behavior is studied at length in rare earth doped transition-metal (RE:TM) thin films. RE:TM alloys of composition Gd_xCo_{100-x}, Gd_xFe_{100-x} and $Gd_x(Co_{50}Fe_{50})_{100-x}$ (30 nm each) deposited on silicon substrates were prepared by magnetron sputtering, where x ranged from 4 to 13 atomic%. The magnetization, uniaxial anisotropy, coercivity and Kerr rotation were investigated as a function of composition. It was found that ferrimagnetism in Gd doped transition metals alloys is considerably influenced by varying concentration of Gd content. At the same time, the magnetic easy axis remains in the film plane whereas the coercivity is strongly reduced after Gd substitution in case of Gd_xFe_{100-x} and $Gd_x(Co_{50}Fe_{50})_{100-x}$ thin films. Results reveal that RE:TM thin films with dilute Gd doping of up to 8% are promising building block in soft magnetic devices for spin-transfer-torque applications, where an enhanced damping is required.

Second topic presents a comprehensive study on degradation of organic dye using metal sulfide nanoparticles. In this research, a series of metal sulfide nanoparticles, such as zinc sulfide (ZnS), cadmium sulfide (CdS) and transition metal ions (Ni, Co, Fe) doped ZnS and CdS nanoparticles were developed through facile co-precipitation method using 2-mercaptoethanol as a surfactant for evaluation of their catalytic and photocatalytic activity potential. The synthesized nano powders were characterized using various analytical chemistry as well as image visualizing techniques like, X-ray diffraction (XRD), field emission spectroscopy (FESEM), energy dispersive spectroscopy (EDX), transmission electron microscopy (TEM), Raman spectroscopy, UV-Vis spectroscopy to elucidate the changes in structure and shape of nanomaterials. Photocatalytic activity experiments show that doped nanoparticles bleach out methylene blue effectively than undoped samples. This research also highlights effect of prepared nanoparticles in degradation of methylene blue by catalytic agent $NaBH_4$. The research at its present stage of development appears to offer the best avenue to remove hazardous pollutants from water. Without

additional chemicals and energy input, this technique can be employed in large-scale water treatment technology, which will have a significant impact on the water purification industry.