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Topic of Research: Surface modification of metal Oxide nanoparticles and their application in water treatment.

Findings

The thesis entitled ***"Surface modification of metal Oxide nanoparticles and their application in water treatment"*** consists of Six chapters. The thesis details out the surface modification of various metal oxide nanocomposites such as CURCA/$MnFe_2O_4$, CS-AC/Mg@SnO_2, FM-MCA/Fe_3O_4, NSS/Fe_3O_4, NAM/$CoFe_2O_4$. These synthesized surface modified metal oxide nanoparticles were exploited as adsorbents for heavy metals and synthetic dyes from aquatic phase. The surface modified nanoparticles were characterized by various spectroscopic techniques like Fourier Transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Vibrating sample magnetometry (VSM), Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), element mapping, N_2 sorption-desorption (BET), Dynamic light scattering (DLS) and Zeta Potential measurement. Non-linear isotherm and kinetic modelling were employed to appraise the equilibrium data. Thermodynamic studies were used to find out the feasibility of the reaction. This chapter deals with the water pollution, different methods of synthesis and the adsorptive efficiency of surface modified metal oxide nanoparticles for inorganic and inorganic contaminants. Water, being the crucial feature of our planet, the contamination of which is a grave matter of concern globally. Elimination of tenacious pollutants from the aquatic phase is indispensable for this planet. Adsorption of pollutants is a best approach to sequester pollutants owing to its design simplicity, economic feasibility, and higher efficiency. Amidst the ample range of adsorbents employed for an environmental cause, surface modified metal oxide nanoparticles (SMON) are emerging as an enticing materials platform for wastewater treatment owing to their high sorption capacity, affinity, environmental viability, tailorable physiochemical characteristics, and better reusability. The presence of various functional groups in the organic moity -COOH, -OH, -NH_2 along with the adsorptive potential of metal oxide validate them as hot spot sorbent. The synthetic methodologies of various surface

modified metal oxide nanoparticles and then their utilization in the seizure of pollutants from the aquatic realm is described thoroughly. The removal mechanism which governs the uptake of pollutant on the surface modified metal oxide nanoparticles has been thoroughly reviewed which illustrated that electrostatic interaction, hydrogel bonding, and complexation are the prime ways to sequester dyes and metals on SMON. Regeneration efficiency was also discussed demonstrating HCl to be potent desorbing agent than various acids and organic solvents. The synthesis of magnetic polymer-metal oxides nanocomposites has gained prominent importance for remediation of different contaminants from aqueous wastes mainly owing to their relatively enhanced surface area, low-cost, eco-friendly nature, stability, and facile retrievability. Herein this study, a novel magnetic poly(curcumin-citric acid)/$MnFe_2O_4$ nanocomposite (CURCA/MFO NC) was developed and assessed for its adsorptive potentiality towards Cr(VI) and celestine blue (CB) from the aquatic phase. The $MnFe_2O_4$ was utilized as a filler in the environmentally benign curcumin-citric acid (CURCA) polymer matrix to upgrade the mechanical strength and boost the adsorption capacity. The purpose of this study was to assess the performance and efficacy of a novel nanocomposite adsorbent based on carom seed-activated carbon (CS-AC) and Mg-doped SnO_2 nanoparticles (Mg@SnO_2 NPs). The CS-AC was prepared using polyphosphoric acid ($H_6P_4O_{13}$) activator, while Mg@SnO_2 NPs were synthesized using a hydrothermal route. The synthesized material was investigated for methyl violet (MV) and malachite green (MG) exclusion from simulated wastewater. In the recent past, natural and/or environmentally compatible synthetic polymers-metal oxide hybrid nanocomposites have been increasingly perceived as cost-viable adsorbents for pollutants segregation. In that context, a novel hybrid nanocomposite of folic acid-mannitol (FAM) co-polymer, synthesized by thermal esterification of both constituents, mosquito coil ash (MCA) and Fe_3O_4, obtained by an easy co-precipitation method, was attained. Recent times have seen an increase in the perception of natural and environmentally friendly, bio-polymers-metal oxides nanocomposites as economically feasible adsorbents for pollutants segregation. In that respect, a unique nanocomposite comprising of natural spider silk fibre (NSS) and Fe_3O_4, was prepared using a co-precipitation approach. The fabrication of NSS/Fe_3O_4 and adsorption of Nile blue. A novel magnetic nicotinamide functionalized nanostructured $CoFe_2O_4$ nanoparticles, NAM/$CoFe_2O_4$ NPs was synthesized through *in-situ* co-precipitation method. The reusability of the spent NPs was consistent up to four adsorption-desorption cycles.