Abstract

The present work discusses about the synthesis of silver nanoparticle supported on biodegradable polymers and the application of this nanoparticle-polymer composite as catalysts for various chemical reactions are elucidated. Noble metal silver was chosen for synthesis of nanoparticle. Sodium alginate, polyvinyl alcohol and polyvinylpyrrolidone are the polymers used as reducing agent, stabilizing agents and support for silver nanoparticles. These polymers are biodegradable and non-hazardous and hence, make the nano-composite catalyst as a green one. UV-Vis spectra, FESEM, XRD, and TEM confirm the formation of spherical silver nanoparticles with a size range of 2-19 nm with uniform distribution on polymer supports. Concentration of silver nanoparticles in the polymer support was determined by AAS analysis. Effect of different process parameters such as concentration of polymer and precursor, heating time and gelling agent, metal salts concentration on synthesis of silver nanoparticles has been studied and described. Catalytic activity of the nano-composite was investigated in different chemical reactions including synthesis of fine chemicals. The reactions chosen are reduction of nitrobenzene, *p*-nitrophenol reduction reaction, condensation reaction of aniline and acetylacetone for β-enaminone preparation and acetylation reactions of aniline and alcohol with acetic acid. Silver nanoparticles embedded calcium alginate shows good catalytic activity and reusability up to 17^{th} run in reduction reaction of *p*-nitrophenol. Heterogeneous kinetic models are proposed for the reaction to find out the best suited one and Eley-Riedel model is found to fit well with the experimental data. Catalytic activity of silver nanoparticles embedded in multilayer polymer composite film was studied in β-enaminone synthesis and effects of different process parameters such as reactant quantity, catalyst loading, different solvents and temperatures on this reaction were investigated. A probable chemical reaction mechanism has also been suggested. The heterogeneous kinetic model following Eley-Rideal pathway showed an excellent experimental data fitting for the reaction. The synthesis of different metal-alginate (CaA, NiA, CuA and ZnA, 'A' represents alginate) supported silver nanoparticles by using microwave irradiation process and their characterization are demostrated in another work. These metal-alginate supported silver nanoparticles (Agnp) are applied as catalysts in acylation of aniline and benzyl alcohol using acetic acid. Thermal stability of all catalysts were studied by TGA analysis. The reusability of the catalysts were described and explained based on their thermal stability. Agnp-ZnA and Agnp-CaA are found to be thermally stable up to 4^{th} and 5^{th} runs respectively in catalyst reusability study, where others cannot withstand more than 3^{rd} run successfully.

Keyword: Nanocatalyst; Polymer composite; Metal alginate; β-enaminone; Acylation reaction; Heterogeneous catalyst.