Abstract

Metal and metal oxide nanoparticles based catalysis has been found to be one of the elegant technologies in our techno-commercial world. As the global population increases with time, the demand of fresh water increases which in turn require to develop eco-friendly and economical approach for purification of water. In this circumstance catalyst catch up the space to convert hazardous compounds present in water into non-toxic products. Catalytic separation process has now become one of the alternative competitive technologies for water treatment process. The present thesis demonstrates fine tuning size of the nanoparticles through eco-friendly approach to assemble catalytic active heterogeneous nanostructured materials and explore the relation between properties of nanomaterials and catalysis with special reference a model catalytic reduction. To achieve this, reduction of 4-nitrophenol (4-NP) in presence of $NaBH_4$ (reducing agent) has been considered as benchmark reaction to assess the catalytic activity of the fabricated nanostructured materials. To examine the model reaction perfectly, various aspects of 4-NP reduction by heterogeneous polymer nanocomposites were analyzed which helps in founding interrelation between nanomaterials properties with catalytic reaction in further discussion. For the fabrication of catalytic nanostructured materials through eco-friendly approach, recently mussel inspired polymers have been come into day light to synthesize highly active nanocatalyst. In this thesis two mussel inspired polymer; polydopamine and polynorepinephrine were used to tune the size of the active silver nanoparticles and magnetic nanoparticles and the activity of their corresponding catalytic nanostructured materials were tested by model catalytic reduction reaction. After considering all aspects, polydopamine have been selected as suitable materials for further progress. On the other hand, between silver nanoparticle and magnetic nanoparticles, silver nanoparticles provides little advantage over magnetic nanoparticles from eco-friendly synthesis approach though magnetic nanoparticles have advantage of easy magnetic separation. Based on this, silver nanoparticles and polydopamine have been chosen to fabricate catalytic membranes to perform the catalytic reduction under dynamic conditions. This overall fabrication of highly active catalytic nanostructured materials would endorse as heterogeneous catalytic application, purification of water and other separation and purification fields of green chemistry in future.

Abstract

Keywords: *Heterogeneous nanostructured materials, Model catalytic reduction, 4-nitrophenol, Polydopamine, Polynorepinephrine, Silver nanoparticles and Magnetic nanoparticles.*