Green and High-Performance Magnetic Catalysts for the Toxicity-Catalytic Reduction of Nitroarene

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Abstract

The reduction of the toxicity of the nitro group to amine is one of the most popular reactions for the synthesis of amines, which are of great importance in various industrial, pharmaceutical and less toxic fields. Heterogeneous catalytic systems based on metal nanoparticles are considered as one of the most promising routes to implement the reduction of nitro group toxicity under sustainable conditions. In this context, we report for the first time the preparation of novel magnetic catalysts with uniform surface area and different particle sizes based on silver and copper nanoparticles supported on a Fe_3O_4-Glycine magnetic nanocomposite, respectively Fe_3O_4-Gly-Ag and Fe_3O_4-Gly-Cu. These heterogeneous catalysts were characterised by several techniques, including X-ray diffraction (XRD), Fourier Transform infrared spectroscopy (FT-IR), Raman spectroscopy, energy dispersive X-ray (EDX) and scanning electron microscopy (SEM). These catalysts have demonstrated excellent catalytic activity in the toxic reduction of nitroarenes to their aminoarene counterparts in the presence of $NaBH_4$ at room temperature in aqueous media, and are magnetically separable using an external magnet without the need for traditional methods such as centrifugation and/or filtration. Furthermore, they are recyclable for up to five cycles without a significant loss of catalytic activity or selectivity.

Keywords:

Toxicity; Reduction; Nanoparticles; Silver; Copper; Glycine; Magnetite; Magnetics; Heterogeneous catalysis; Nitroarenes; Amino-arenes; and Recycling.