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Synthesis and catalytic application of magnetic metal ferrite nanoparticles in organic reactions

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Bimetallic nanoparticles are a class of nanomaterials with new physical and chemical properties resulting from synergistic effects between the two metals. MFe_2O_4, where M is a divalent transition metal, is the formula of one important family of these bimetallic compounds called metal ferrites. These structures crystallize in the spinel form showing super-paramagnetic properties originating from the moment of antiparallel spines between ferric ions at tetrahedral sites and M^{2+} ions at octahedral sites. The unusual structural, electronic, magnetic and catalytic properties of these nanodimensional transition metal spinel oxides provide potential application in various fields, such as preparation of high density recording devices, gas sensors, and high efficient catalysts. Ferrites used in catalytic applications are generally synthesized by low temperature co-precipitation methods which overcome the drawbacks such as low surface area, varying morphology, inhomogeneity at an atomistic level and large particle with grain boundary, generally associated with high temperature preparation. Further, co-precipitation methods generate Bronsted acid sites in different cationic environment in addition to Lewis sites, which makes the catalyst active and effective for many organic transformations such as aromatic alkylation, acylation, etc. It has been proved that these nanoparticles show very good catalytic activity in C-C and C-heteroatom bond formation. During the last couple of years, application of different types of these magnetic catalysts has shown in various organic transformations by our group [1-5]. They have employed in C-N, C-O and C-C coupling reactions successfully; still, there are a lot more transformations that can be done using the catalytic properties of these compounds.

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