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APPLICATIONS OF NANO-MAGNETITE SUPPORTED CATALYSTS IN ORGANIC CHEMISTRY

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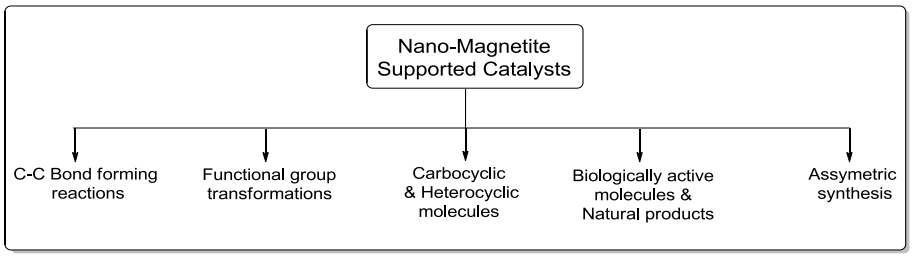
ABSTRACT

Nano-Magnetite Catalysts were successfully employed synthetic organic chemistry due to their high surface area, less reaction time, high yields, high selectivity, simple workup, reusable, easy to preparation & handle and low cost. In future, these catalysts could be useful in multidisciplinary research includes biotechnology, biomedicine etc.



INTRODUCTION

Nano-Catalysts are gradually emerging in the field of synthetic organic chemistry. These catalysts are growing attention because these catalysts have the features: high surface area, less reaction time, high yields, high selectivity, simple workup, reusable, easy to preparation & handle and low cost. Magnetite has a cubic inverse spinal structure with space group of Fd3m. It is an ideal oxide support, easy to prepare, having a very active surface for absorptions or immobilization of metals and ligands, which can be separated by magnetic decantation after reaction. Therefore, magnetite nanoparticles[1-3] are one of the most widely studied materials in multidisciplinary research includes biotechnology, biomedicine, MRI, catalysis etc. (Fig. 1).

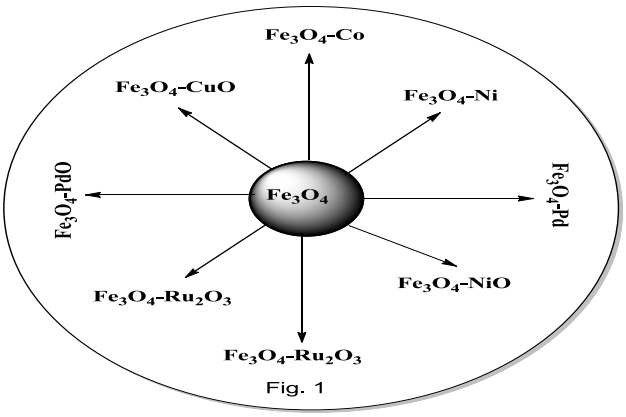


Fig. 1

Applications: In future these catalysts will play a significant role in organic synthesis[4-9], in addition these catalysts with linkers and ligands will play an important role in asymmetric organic synthesis, pharmaceutical and chemical industries.[10-24] These catalysts were successfully used for the formation of C-C bond reactions, functional group transformations, synthesis of heterocyclic and carbocyclic molecules, biologically active molecules and natural products (Fig.2). Moreover these catalysts are extending via linkers and ligands in asymmetric organic chemistry. Hence at present there is much understanding on nano-magnetite catalysts in synthetic organic chemistry, in approaching these catalysts will play a vital role in organic synthesis and asymmetric synthesis in pharmaceutical and chemical industries.

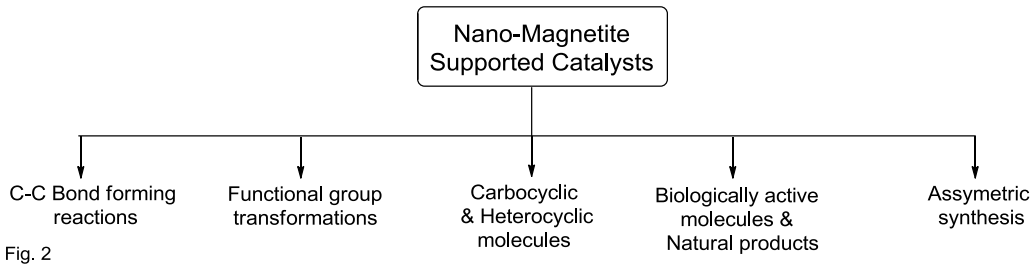
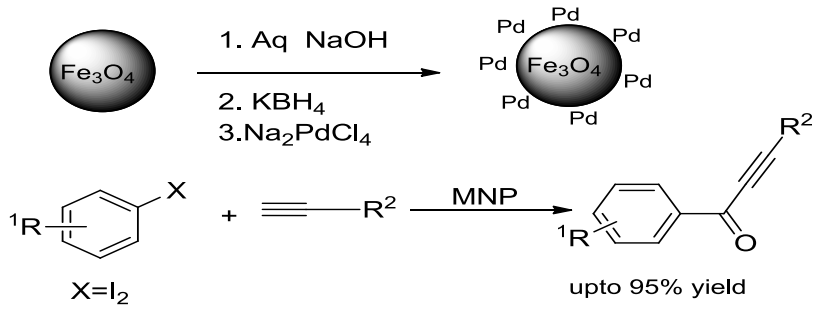


Fig. 2

Very recently synthesis and applications of these catalysts in organic chemistry have been successfully developed. Some of the recent work for C-C bond forming reactions[19], functional group transformations[20,21], multicomponent reactions[22], heterocyclic compounds[23] and asymmetric synthesis[23] presented few recent work below.

1. C-C Bond forming reaction

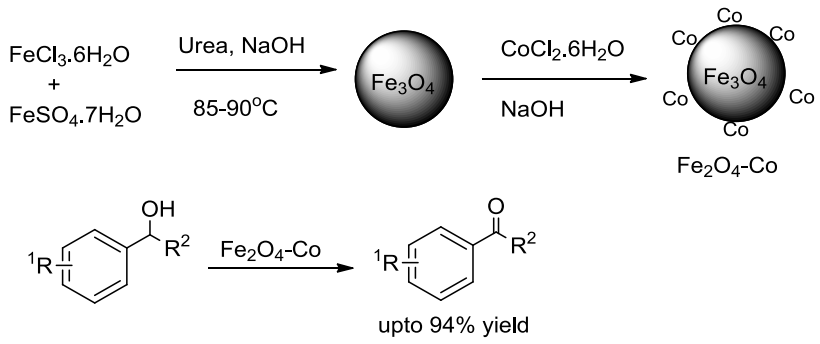
Fe_3O_4-Pd catalyzed employed for Sononagashira coupling reaction[19] of several aromatic aryl halides and alkynes in high yields (Scheme 1).



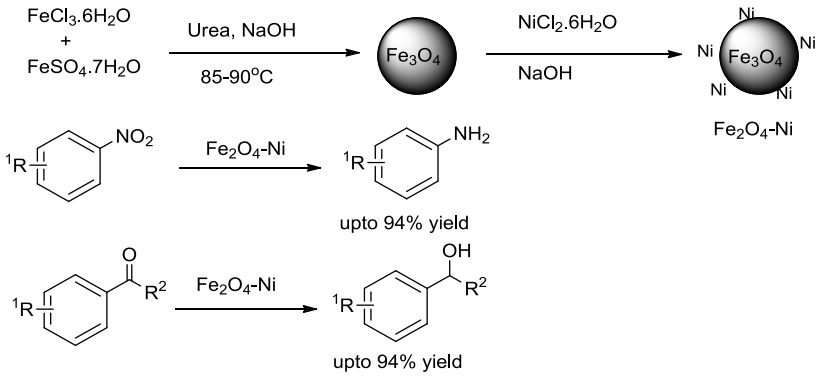
Scheme 1. Sonagasgira coupling

2. Functional group transformations

Gawande[20] *et. al.* used cobalt-magnetite catalyst for the oxidation of alcohols with high yields (Scheme 2). Further very recently they used Ni-magnetite catalyst for the selective reduction of nitro-group of halogenated nitroarenes. The same catalyst also successfully employed for reduction of carbonyl compounds[21] (Scheme 3).



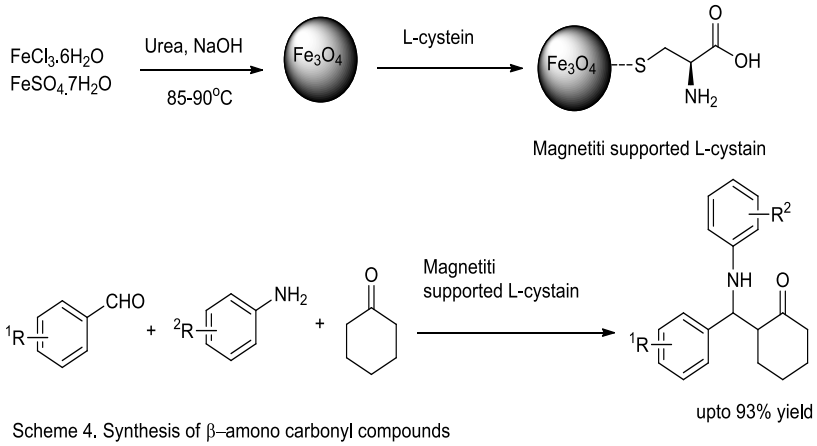
Scheme 2. Oxidation of alcohols



Scheme 3. Reduction of aromatic nitro and carbonyl compounds

3. Multicomponent reactions

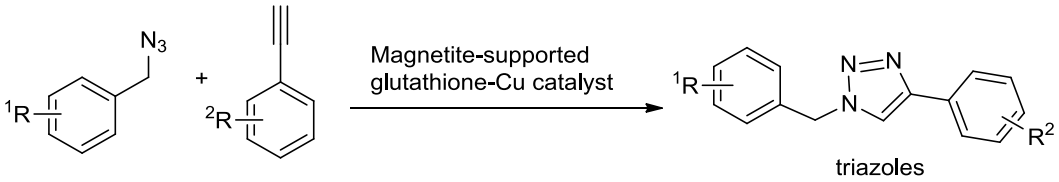
Gawande[22] et al recently established magnetite linked L-cysteine for synthesis of β-amino carbonyl compounds reaction between aniline, benzaldehyde and cyclohexanone (Scheme 4).



Scheme 4. Synthesis of β–amono carbonyl compounds

4. Heterocyclic molecules

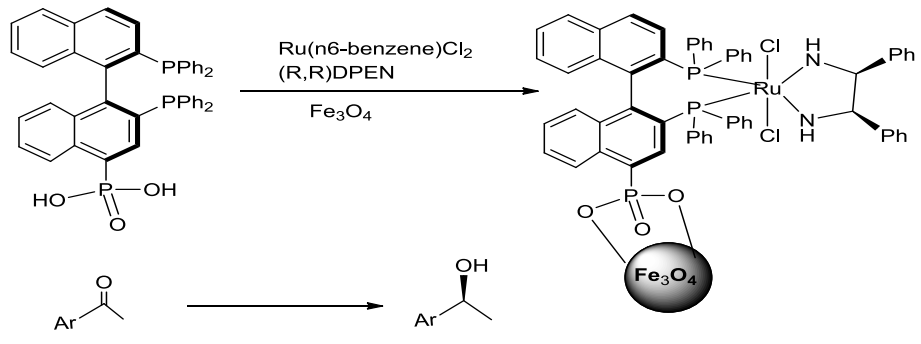
Recently Cupper-magnetite-glutathione catalyst[23] used for the synthesis of 1,2,3-triazole compounds in aqueous media under MW irradiation. Selectively 1,4 products obtained in high yield with this catalyst.



Scheme 5. Synthesis of 1,2,3-triazole

5. Asymmetric hydrogenation

Ru-Magnetite supported catalyst[24] prepared for asymmetric hydrogenation of aromatic ketones for this first they prepared 4-phosphonic acid substituted R-BINAP which was followed by Ru complex through phosphonate group onto the surface of magnetite. Asymmetric hydrogenation of aromatic ketones did up to 98% ee of corresponding alcohols (Scheme 6).



Scheme 6. Assymetric hydrogination of aromatic ketones

CONCLUSIONS

Nano-Catalysts were successfully employed synthetic organic chemistry due to their high surface area, less reaction time, high yields, high selectivity, simple workup, reusable, easy to preparation & handle and low cost. In future, these catalysts could be useful in multidisciplinary research includes biotechnology, biomedicine etc.

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