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Synthesis of Magnetic Nanocomposites and Their Potential Applications: A Review

Manohar R. Patil*

Nano-Chemistry Research Laboratory, G.T.Patil College, Nandurbar-425412, (M.S.), **INDIA**

E-mail: profmanoharpatil@gmail.com

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ABSTRACT

In present review article I have reported the field of Nanotechnology under worldwide research is the subset of magnetic Nano-materials like nano-composites, nano-thin films etc. In this review, discussed the importance of magnetic nanocomposite and their unique application for technological advances, and explain the bottom-up synthesis of magnetic nano-composites by various methods like Sol-gel or co-precipitation method. Some of the current updates were described and research for application of these magnetic nanocomposites.

Keywords: Magnetic-Nanocomposite, Sol gel method, Co-precipitation, Thermal decomposition and Applications.

INTRODUCTION

The synthesis of magnetic Nano sized material has been carried out using different physical and chemical methods. Physical methods like thermal decomposition, spray pyrolysis, spin coating etc. are used. The chemical methods like hydrothermal, solvothermal, sol-gel [1], and chemical deposition methods have been used. Some of them are discussed as follows: The thermal decomposition synthesis a powerful method for producing magnetic iron oxide Nano crystals with high quality in terms of crystalline degree, particle size distribution, and particle size tenability [2]. Surface modification of magnetic nanoparticles is a challenged key for different applications and can be accomplished by physical and chemical adsorption of organic compounds. From the rudimentary research perspective iron (III) oxide is a convenient compound for the general study of polymorphism and the magnetic and structural phase transitions of nanoparticles. The subsistence of amorphous Fe_2O_3 and four polymorphs i.e. alpha, beta, gamma and epsilon, is well established. The most frequent polymorphs structure alpha (Hematite) having rhombohedra – hexagonal structures and cubic spinal structure gamma (maghemite) have been found in nature. At a temperature of 650°C, hematite turns into Fe_3O_4 with high energy loss. Prepared magnetic core shelled Fe_3O_4 nanoparticles to ameliorate colloidal dispersion and to control particle sizes. An advantage of this technology was that the nanofluid acted only as a carrier for the antibiotic. In integration, diminutive magnetic nanoparticles sanctioned distribution of an antibiotic when certain organ such as the brain and kidney. Iron oxide nanocomposite has better potential applications in the areas of magnetic recording, magnetic data storage contrivances, toners, magnetic resonance imaging, wastewater treatment, bioseparation, bio

medicines etc. [**3, 4**]. Numerous types of magnetic nanoparticles for various applications could be tailored by using functionalized natural or synthetic polymers to impart surface reactivity [**5-8**].

Magnetic Nano adsorbent has been proposed as alternative conventional method for the economic removal of suspended solids, dissolved nutrients, heavy metals, pathogens, chemical dyes and organic moieties from wastewater. It is well known that heavy metal ions and organic compounds remains a serious environmental problem facing the world for water pollution, As a result of their numerous industrial applications. In addition many of them are known to be toxic or carcinogenic even at low concentration, on biodegradable and tend to accumulate in living organism causing a serious disease and disorders. Therefore their presence in water should be controlled [**9-10**].

MATERIALS AND METHODS

Synthesis of Magnetic Nanoparticles by Co-precipitation methods: Several researchers have been synthesizing magnetic nanoparticles by using co-precipitation method. Generally Fe_3O_4 crystal was achieved under basic condition, by maintaining the molar ratio of Fe $(NO_3)_3 9H_2O$:$FeSO_4 6H_2O$ as 1:2 ratios [**11-12**].

The solution of Fe_3O_4 Nano-particle, monomer aniline, and ammonium per-sulphate were prepared in distilled water with vigorous stirring at room temperature. The amount of Fe_3O_4 and monomer aniline was taken in 1:2 ratios. The magnetic polymer Nano-composite was synthesised [**13**].

Preparation of Fe_3O_4 -RGO Hybrid Nanomaterial's: The Fe_3O_4 was prepared by conventional co-precipitation method. Graphene oxide and hybrid Nano composites were prepared by researcher **[14]**.

Synthesis of Fe_2O_3/$CuFe_2O_4$/chitosan nanocomposites: Fe_2O_3/$CuFe_2O_4$/chitosan nanocomposites were also synthesised using Sol-gel method by couple of researchers [15-16].The polyelectrolyte stabiliser is also used for synthesis of magnetic nanocomposite [**17**].

APPLICATIONS

In MRI: Super paramagnetic particles are used as magnetic resonance imaging (MRI) contrast agent in diagnostics applications [**18**] MRI may be used to enhance the image contrast between normal and diseased tissue and or indicate the status of organ functions or blood flow Small super paramagnetic iron oxides (SPIOs) have been developed for imaging liver metastases and to distinguish loops of bowel from other abdominal structures [**19**].

In Cancer Diagnosis: The size, shape and composition of magnetic nanoparticles being trialed as biochemical probes depend of their intended application, as well as the method of fabrication. The magnetic nanoparticles are very attractive for diagnostic tools of cancer tumors and targeting treatment in cancer and HIV infection [**20**].

In removal of Pollutants: Several researchers have been using magnetic Nanocomposite for the pollution control. Most of the pollutants (mainly dyes) are synthetic in nature and are conventionally composed of aromatic rings in their molecular structure, which makes them carcinogenic, mutagenic, inert, and non-biodegradable when discharged into aqueous streams without felicitous treatment. Therefore, the abstraction of such colored agents from the polluted aqueous stream is very exigent predicated on the point of human health and environmental resource auspice [**21-25**]. Magnetic nanocomposite has been found to be a potential alternative in future for materials with low photocatalytic activity. Degradation of organic pollutants and toxic dyes has been a paramount aspect to study the photocatalytic efficiency of magnetic composites [**26, 27**]. Adsorption studies of various

dyes on activated carbon Fe_3O_4 Magnetic Nano Composite done by S.Sivaprakash and co-workers [28]. Similar work here carried by several researcher using different nanocomposites [29-31].

CONCLUSION

Magnetic nanocomposites synthesis is very much affordable and it is done by several researchers. Magnetic nanocomposite has been used in various emerging fields such in medicines, MRI, Cancer diagnosis, therapeutic use and potentially used in water pollution control. Several researchers have been tried their best in this field. Hence, I potentially recommend magnetic nanocomposites are better material of future in various fields.

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