Journal of Nanomaterials & Molecular Nanotechnology

Research A SCITECHNOL JOURNAL

# Micro Emulsion-A Facile Route for the Fabrication of Ferrite Magnetic Nanoparticles: A Mini Review

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**Received date:** January 03, 2022; **Accepted date:** January 20, 2022; **Published date:** January 27, 2022

### Abstract

Ferrite Nanoparticles (FNPs) have received a considerable amount of attention due to their exceptional physical, optical, magnetic and electronic properties and wide applications as high density storage materials, catalysts, gas sensors, rechargeable lithium batteries, magnetic bulk cores, adsorbents, magnetic fluids, information storage system, microwave absorbers and medical diagnostics. The design and synthesis of Nano magnetic particles has the focus of the intense fundamental and applied research with special emphasis on their enhanced properties Fabrication of spinel ferrites through micro emulsion provides excellent control over particle size and shape and interparticle spacing. The present paper aims to the use of micro emulsion as Nano reactors for the synthesis of spinel ferrites.

**Keywords:** Microemulsion; Spinel; Superparamagnetic; Magnetism.

## Introduction

Ferrite has been acknowledged for years to be the most useful soft magnetic materials with spinel structure. Owing to high electrical resistivity, permanency and electromagnetic possessions, ferrite has been rummage- sale in high power maneuver and high rate of recurrence cases, such as transformers and telecommunication solicitations. The compositions, arrangement of molecule, size, shape and sintering temperature are deciding factors of the properties like permeability, electrical resistivity, magnetic coercivity and loss of Eddy currents. A huge amount of experimental data has been serene with huge discrepancies because of dependency of magnetic properties of these nanocrystals on synthetic conditions, composition, shape and size [1,2]. The scarce physiochemical properties possess by magnetic nanocrystals lead to conjure interest, which shows way to development of new experimental routes for the controlled synthesis of nanomaterials. Most Scientists have engrossed on monodisperse metals, metal alloys, dualistic and ternary metal oxides magnetic nanocrystals, however more than three components monodisperse compounds investigated not as much of [2,3]. There are lots of method to synthesize these materials, few of them are, sonochemical, ball-mill, chemical co-precipitation, sol-gel and reverse microemulsion [4-9]. The present paper aims at a short review on study of synthesis of magnetic nanoparticle using microemulsion technique and compare with chemical precipitation.

### Fabrication of Co, Zn-ferrite nanoparticles by reverse microemulsion

Co, Zn-Ferrite has been synthesized by reverse microemulsion in my previous work [10,12].

### Fabrication of Ni, Zn-ferrite nanoparticles by reverse microemulsion

Ni, Zn-Ferrite has been synthesized by reverse microemulsion in my previous work [11,12].

### Fabrication of $Co_{0.5}Zn_{0.5}Fe_2O_4$ and $Ni_{0.5}Zn_{0.5}Fe_2O_4$ ferrite nanocrystals by chemical coprecipitation process

Co, Zn- Ferrite and Ni, Zn- ferrite has been synthesized by Chemical co-precipitation in my previous work [12].

## Results and Discussion

### Crystallographic Studies

The crystal structure of Co0.5Zn0.5Fe2O4 and Ni0.5Zn0.5Fe2O4 ferrite nanoparticles synthesized by reverse microemulsion and chemical co-precipitation route respectively have been well explained by X-Ray diffractogram (Figure 1). All diffraction peaks in aspect of relative intensity and peak position observed for both the samples harmonized well with standard powder diffraction data. Bragg's reflection of planes, which can be readily indexed to the spinel phase, could be accredited to the diffraction peaks at different 2θ values (Figures 2 and 3).

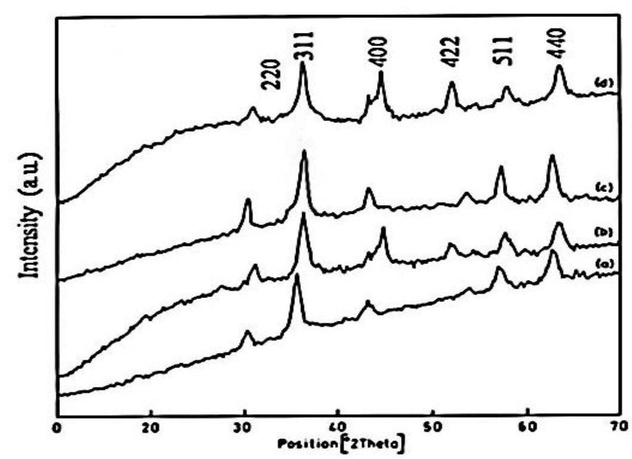


**Figure 1:** XRD patterns of (a) Co0.5Zn0.5Fe2O4 and (c) Ni0.5Zn0.5Fe2O4 ferrite nanoparticles obtained from chemical co-precipitation and XRD patterns of (b) Co0.5Zn0.5Fe2O4 and (d) Ni0.5Zn0.5Fe2O4 ferrite nanoparticles obtained from reverse microemulsion. All the samples sintered at 600˚C for 4 hours.

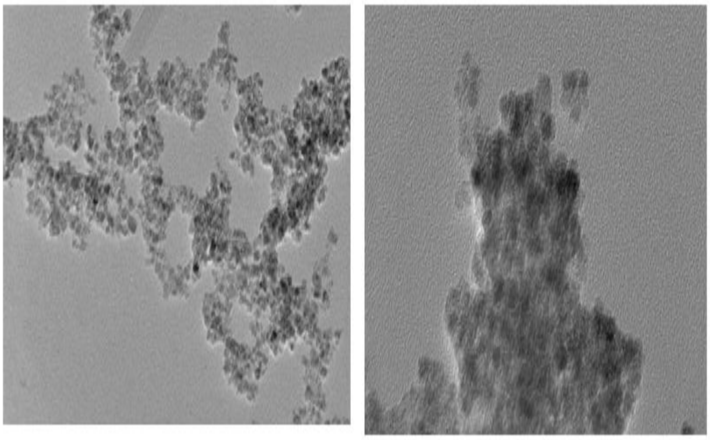

**Figure 2:** TEM (a) and FETEM (b) images of Co0.5Zn0.5Fe2O4 ferrite nanoparticles obtained from reverse microemulsion.

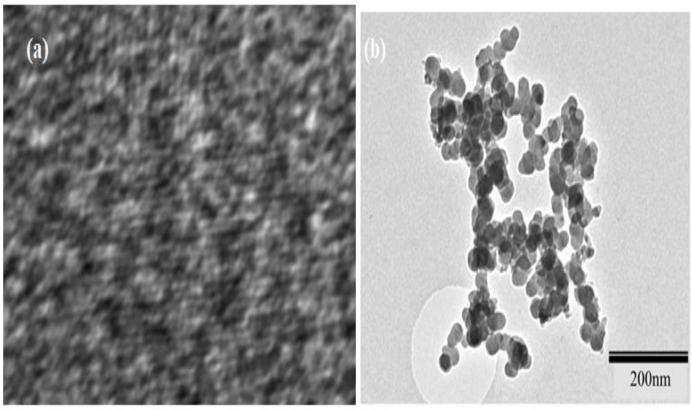


**Figure 3:** (a) Magnified lattice obtained in FETEM image represented in (a) and (b) TEM image of Co0.5Zn0.5Fe2O4 ferrite nanoparticles obtained from chemical co-precipitation.

### Spectral analysis

Figure 4 depicts Typical FTIR spectra of Co0.5Zn0.5Fe2O4 and Ni0.5Zn0.5Fe2O4 ferrite nanoparticles obtained from reverse micro emulsion and chemical co-precipitation route. The spectra presented in the manuscript are of the particles heated at 600ºC for 4 hours. The nanoparticles were heated at 600˚C for 4 hours because initially the size of the synthesized nanoparticles was so small that exceptionally scrawny strength peaks due to the core pulsations of the tetrahedral and octahedral sites were perceived. The FTIR spectra of both ferrite nanoparticles unveil peaks around 3444 cm-1 and 1600 cm-1 endorsed to the elongating vibrations of hydrogen-bonded surface water molecules and hydroxyl groups The peak near 1600 cm-1 could be endorsed to in-plane O-H bending of adsorbed water [12]. In ferrites metal ions are situated in two different sub lattices, designated as tetrahedral and octahedral.

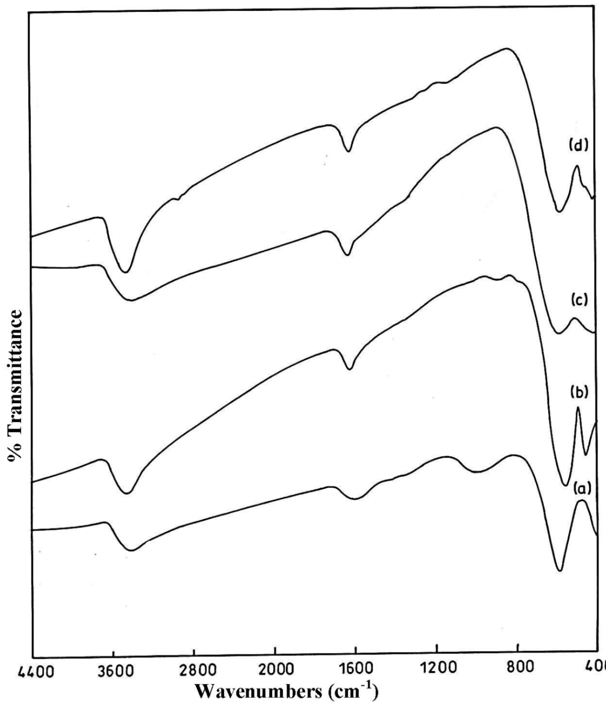


**Figure 4:** FTIR spectra of (a), (b) Co0.5Zn0.5Fe2O4 and (c), (d) Ni0.5Zn0.5Fe2O4 ferrite nanoparticles obtained from chemical co-precipitation and reverse microemulsion, respectively. All the samples sintered at 600˚C for 4 hours.

## Conclusion

Our studies establishes that reverse micro emulsion could be used for the fabrication of meticulous designs of the ferrite nanoparticles. The reverse micro emulsion route gives a successful way for preparing different ferrite nanoparticles with diameter 1-5 nm at low temperature.

First, the synthetic process is found to be economical and environmentally friendly, because it involves reasonable and less lethal iron salts and a reduced quantity of organic solvent. Second monodisperse and crystal clear nanoparticles were produced. Hence reverse microemulsion is the best method for synthesis of magnetic nanoparticle on metal oxide.

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