

TWO DAYS NATIONAL LEVEL CONFERENCE

ON

**ROLE OF
PHYTOCHEMICALS AND
ADVANCED MATERIALS IN
CANCER PREVENTION
AND RESEARCH**

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A REVIEW ON COPPER FERRITE AND METAL DOPED COPPER FERRITE MATERIALS: SYNTHESIS AND ITS MAGNETIC PROPERTIES

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Abstract

In recent years, copper ferrite (CuFe_2O_4) nanomaterials has gained much attention for researchers due to its diverse application in the field of science and technology. Herein we report some synthetic method of preparation of copper ferrite and metal doped copper ferrite nanomaterials. A versatile way in which CuFe_2O_4 nanoparticles can be fabricated and the influence of the method used on the physical and magnetic properties of the materials

Keywords: copper ferrite, spinel ferrite, metal doped nanoparticles, magnetic properties.

1. INTRODUCTION

Spinel ferrites are given by general chemical formula AB_2O_4 where A and B are metal cations placed at tetrahedral and octahedral sites, respectively. Spinel ferrite should contain ferric (Fe^{3+}) ion in its chemical formula. The most common examples of spinel ferrites are represented by MFe_2O_4 (where M can be any metals with an oxidation state of +2, such as Co^{2+} , Cu^{2+} , Fe^{2+} , Mn^{2+} , Ni^{2+} and Zn^{2+} ¹⁻⁵). CuFe_2O_4 is a spinel ferrite material having capacity to modify its physical properties such as semiconducting, magnetic, electrical, phase transitions, electrical switching and stability occurs if they treated under various environmental conditions. Copper ferrite can be described as a cubic close-packed arrangement of oxygen ions, with Cu^{2+} and Fe^{3+} ions at two different crystallographic sites. Additionally they are considered as low-cost magnetic material. Copper based nanomaterials act as catalysts, in electrocatalysis, photocatalysis, and gas-phase catalysis. The structural, morphological, and optical properties of nanomaterials were characterized extensively by techniques such as FT-IR, XRD, EDX, SEM, TEM, and UV-vis. Various methods have been adopted to prepare copper ferrite nanomaterials since the size, shape and morphology of nanomaterials prepared will depends on the method of synthesis. There are several synthesis methods available for CuFe_2O_4 such as hydrothermal, coprecipitation, sol-gel auto combustion, thermal treatment, high energy ball milling, combustion, Microemulsion, solid state reaction, polyol route, microwave-assisted hydrothermal and mechanochemical method. Co-precipitation method is environmentally favourable in view of the fact that only deionized water is used as a solvent, whereas the other methods use organic solvents.

2. SOL-GEL METHOD

Sol-gel is a low temperature, cost effective and highly controllable method for the production of homogeneous, highly stoichiometric and high quality ultrafine nanomaterials. Also, a wet-chemical technique that uses a chemical solution or colloidal

particles to produce a gel. copper ferrite (CuFe_2O_4) nanoparticles prepared through a modified sol–gel method using copper (II) nitrate, iron (III) nitrate and starch as starting materials in water as solvent. The photocatalysis results reveal that the decolorization of 53 % for methyl orange occurred with CuFe_2O_4 nanoparticles in 90 min under UV light irradiation⁶.

3.CHEMICAL CO-PRECIPIATION METHOD

Chemical co-precipitation is a very facile and convenient way to synthesize nanoparticles from aqueous salt solutions by the addition of a base under inert atmosphere at room temperature or at elevated temperature. Copper ferrite were synthesized by chemical coprecipitation reaction using iron chloride, $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$, copper chloride, $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ and octanoic acid ($\text{C}_8\text{H}_{16}\text{O}_2$) of HPLC grade as surfactant. The sample showed a typical ferromagnetic behavior at room temperature with finite coercivity of 245.5 Oe at 300 K⁷.

4.AUTO- COMBUSTION METHOD

Manganese substituted copper ferrite nanoparticles were synthesized by an auto-combustion technique using metal nitrates and urea for gas sensor application. The products were characterized by XRD, SEM, EDX, TEM and VSM techniques. The effect of annealing temperature on the particle size, magnetic and dielectric properties of Mn–Cu ferrite nanoparticles was analyzed. The size of the particles is in the range of 9–45 nm⁸.

5.DOPING OF COPPER FERRITE

Hydrothermal synthesis technique was chosen as it can provide good homogeneity, crystallinity, low reaction temperatures, inexpensive, less power consumption, easy sample preparation, high purity and stability. Barium doped CuFe_2O_4 by hydrothermal method showed cubic spinel structure with an average crystallite size of 24 nm and exhibiting super para magnetic in nature⁹. Cerium doped copper ferrite nanoparticles by auto combustion method achieved using lactose and glucose as the two capping agents and found that increasing the concentration of the lactose and glucose causes to increase the particle size of final products. Simultaneously, products lead to agglomeration of nanoparticles¹⁰. Mg doped copper nanoferrite was prepared by standard ceramic and wet method with particle size ranging from 8.7 to 41.1 nm. Bismuth substituted copper ferrite nanoparticles are prepared by solution combustion route by using metal nitrates. The relative humidity of $\text{Bi}_x\text{CuFe}_{2-x}\text{O}_4$ nanoparticles in the range from 10% RH to 90% RH at room temperature is generated. With the substitution of bismuth, the sensitivity factor is decreased at low relative humidity¹¹.

6.MAGNETIC PROPERTIES OF COPPER FERRITE

CuFe_2O_4 are considered to be part of a group of soft magnets. There are several factors such as synthesis method, crystalline size, pH, calcination temperature, doping and dopant type have been investigated and were found to have an influence on the physical and magnetic properties of CuFe_2O_4 as well as other spinel ferrites. It is alleged that the M_s of CuFe_2O_4 increase with an increase in the crystalline sizes which is supported by the dead layer like a core-shell model theory, which suggests that when the crystalline sizes are small, the magnetic NPs are shielded inside by a nonmagnetic layer

while the dead layer refers to the disorder of the surface spins. Hence, this increase in the surface spins which is observed with a decrease in crystallinity contributes greatly to low M_s ¹²⁻¹³.

7. CALCINATION TEMPERATURE

Calcination temperatures between 200 and 1100°C employed on CuFe_2O_4 NPs resulted in an increase in M_s Values with an increase of temperature. This observed increase is attributed to two different reasons. Firstly, to the phase change of CuFe_2O_4 NPs from the cubic phase which is observed for at low temperature to tetragonal phase that is observed at higher sintering temperatures¹⁴⁻¹⁶? Secondly to the increase in particle size and the high crystallinity that is observed on CuFe_2O_4 NPs. Nevertheless, the increase in sintering temperature was found to increase the H_c and this is attributed to the phase evolution, an increase in anisotropy and growth of the CuFe_2O_4 NPs. However, the H_c can also be reduced by increasing calcination temperature to a level where the grain size is large enough to decrease the grain boundary volume which leads to the pinning effect of the domain wall of CuFe_2O_4 NPs¹⁷.

8. CONCLUSION

CuFe_2O_4 NPs using dopants, it is clear that random guessing was used to select the dopant. Different dopants have been added to the CuFe_2O_4 NPs with the aim of increasing its M_s , however, some dopants increased the M_s while others decreased it, thus the area requires more work in order to select the best dopant that improves the M_s values of CuFe_2O_4 NPs.

References

1. D.H.K. Reddy, Y.-S. Yun, Spinel ferrite magnetic adsorbents: Alternative future materials for water purification? *Coord. Chem. Rev.* 315 (2016) 90–111.
2. D.H. Taffa, R. Dillert, A.C. Ulpe, K.C.L. Bauerfeind, T. Bredow, D.W. Bahnemann, M. Wark, Photoelectrochemical and theoretical investigations of spinel type ferrites ($\text{M}_x\text{Fe}_{3-x}\text{O}_4$) for water splitting: a mini-review, *J. Photon. Energy* 7 (2016) 012009,
3. V.D. Silva, L.S. Ferreira, T.A. Simões, E.S. Medeiros, D.A. Macedo, 1D hollow MFe_2O_4 (M = Cu, Co, Ni) fibers by solution blow spinning for oxygen evolution reaction, *J. Colloid Interface Sci.* 540 (2019) 59–65.
4. K.K. Kefeni, B.B. Mamba, T.A.M. Msagati, Application of spinel ferrite nanoparticles in water and wastewater treatment: a review, *Sep. Purif. Technol.* 188 (2017) 399–422.
5. N. Guijarro, P. Bornoz, M. Prévot, X. Yu, X. Zhu, M. Johnson, X. Jeanbourquin, F. Le Formal, K. Sivula, Evaluating spinel ferrites MFe_2O_4 (M = Cu, Mg, Zn) as photoanodes for solar water oxidation: prospects and limitations, *Sustain. Energy Fuels* 2 (2018) 103–117.
6. Mohammad Vosoughifar, Preparation and application of copper ferrite nanoparticles for degradation of methyl orange, *J Mater Sci: Mater Electron*, 2016.
7. Masoud Salavati-Niasari, Tahmineh Mahmoudi, Mohammad Sabet, S. Mostafa Hosseinpour-Mashkani, Faezeh Soofivand, Farnosh Tavakoli, Synthesis and

- Characterization of Copper Ferrite Nanocrystals via Coprecipitation, *J Clust Sci* (2012) 23:1003–1010 DOI 10.1007/s10876-012-0486-7.
8. E. Ranjith Kumar, R. Jayaprakash, G. Sarala Devi, P. Siva Prasada Reddy, Magnetic, dielectric and sensing properties of manganese substituted copper ferrite nanoparticles, *Journal of magnetism and magnetic materials*, 355 (2014), 87-92,
 9. U. Naresha, R. Jeevan Kumara, K. Chandra Babu Naidub, Hydrothermal synthesis of barium copper ferrite nanoparticles: Nanofiber formation, optical, and magnetic properties, *Materials Chemistry and Physics*, 236 (2019),
 10. Mehdi Rahimi-Nasrabadi, Mohsen Behpour, Ali Sobhani-Nasab, Mansoureh Rangraz Jeddy, Nanocrystalline Ce-doped copper ferrite: synthesis, characterization, and its photocatalyst application, *J Mater Sci: Mater Electron*, 2016.
 11. Pradeep Chavan, L.R. Naik, Effect of Bi^{3+} ions on the Humidity Sensitive Properties of Copper Ferrite Nanoparticles, *Sensors and Actuators B*, 2018.
 12. R.S. Yadav, J. Havlica, J. Masilko, L. Kalina, J. Wasserbauer, M. Hajdúchová, V. Enev, I. Kuřitka, Z. Kožáková, Cation migration-induced crystal phase transformation in copper ferrite nanoparticles and their magnetic property, *J. Supercond. Nov. Magn.* 29 (2016) 759–769.
 13. Z. Karcioğlu Karakaş, R. Boncukcuoğlu, İ.H. Karakaş, M. Ertuğrul, The effects of heat treatment on the synthesis of nickel ferrite (NiFe_2O_4) nanoparticles using the microwave assisted combustion method, *J. Magn. Mater.* 374 (2015) 298–306.
 14. A.B. Ghumare, M.L. Mane, S.E. Shirsath, K.S. Lohar, Role of pH and sintering temperature on the properties of tetragonal–cubic phases composed copper ferrite nanoparticles, *J. Inorg. Organomet. Polym. Mater.* 28 (2018) 2612–2619.
 15. R.S. Yadav, J. Havlica, J. Masilko, L. Kalina, J. Wasserbauer, M. Hajdúchová, V. Enev, I. Kuřitka, Z. Kožáková, Cation migration-induced crystal phase transformation in copper ferrite nanoparticles and their magnetic property, *J. Supercond. Nov. Magn.* 29 (2016) 759–769.
 16. M.V. López-Ramón, M.A. Álvarez, C. Moreno-Castilla, M.A. Fontecha-Cámara, Á. Yebra-Rodríguez, E. Bailón-García, Effect of calcinations temperature of a copper ferrite synthesized by a sol-gel method on its structural characteristics and performance as Fenton catalyst to remove gallic acid from water, *J. Colloid Interface Sci.* 511 (2018) 193–202,
 17. S. Pavithradevi, N. Suriyanarayanan, T. Boobalan, Synthesis, structural, dielectric and magnetic properties of polyol assisted copper ferrite nano particles, *J. Magn. Mater.* 426 (2017) 137–143.