

FTIR AND ALSO ARCHITECTURAL CHARACTERISTICS OF CO-PRECIPIATED COBALT FERRITE NANO PARTICLES

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ABSTRACT:

The FTIR and structural properties in co-precipitated cobalt ferrite (CoFe_2O_4) nanoparticles are discussed in this paper. The synthesis was conducted at temperatures of 75°C and 95°C following post annealing at 1200°C for 5 hours. Other modification samples were synthesis at temperature of 95°C and then annealing at temperature of 1000°C and 1200°C for 5 hours. For both modification of synthesis and annealing temperature, FTIR result showed a metal oxide at a wave number of 590 cm^{-1} which indicated cobalt ferrite nanoparticles. The crystalline structure was confirmed using x-ray diffraction that the high purity of cobalt ferrite was realized. Calculation of the cation distribution by using comparison I_{220}/I_{222} and I_{422}/I_{222} show that the synthesis and annealing temperature successfully modify cation occupy the site octahedral and tetrahedral.

Keywords: HPLC, PDA, stability indication method, drug.

1. INTRODUCTION:

Study of ferrite based nano particles show great progress in the past decade due to the interesting techniques and developments to achieve the nano-meter order of magnetic particles. At the nanoscale, there is new behaviors and properties which is different from bulk structures [1-3]. Especially in ferrite which is materials with high chemical stability and low production cost already used for many application field [4]. Ferrite based nanoparticles currently used in application such as optical materials [5], semiconductors [6], nanofluids [7-9], and at the superparamagnetic stage [10] used for magnetic data storage [11], magnetic imaging, and biomedical applications [12]. Ferrite is spinel structured materials which is isostructural with the mineral MgAl_2O_4 and have general molecular formula $(\text{M}^{2+})_2[\text{Fe}^{2+}]_4\text{O}_4$, with M^{2+} is divalent cation and Fe^{3+} is trivalent cation [13]. Its crystallises is face centered cubic containing eight formula unit $[\text{AB}_2\text{O}_4]_8$ or 56 ions per unit cell. The lattice consist of 32 divalent oxygen arrange with 64 tetrahedral interstitial and 32 octahedral interstitial sites (just 8 tetrahedral and 16 octahedral sites are occupy by divalent and trivalent cations) [14]. In this large empty interstitial sites, there is possibility to cation migration [15]. For normal spinel materials such as ZnFe_2O_4 , all the divalent cations occupy the tetrahedral sites (A-sites) and all the trivalent cations occupy the octahedral sites (B-sites). In contrast for inverse spinel such as MgFe_2O_4 , trivalent cations are distributed at the A-sites and B-sites, whereas divalent cations have preference for B-sites. Distribution of cations in each lattice sites form materials as inverse or

partially inverse [16]. The distribution of cations over the two interstitial sites is strongly affected by the variations of lattice constants, size of crystallites, and bond angles-bond length between the cations [17]. One of the most interesting ferrite is cobalt ferrite (CoFe_2O_4) due to their strong magnetocrystalline anisotropy, high coercive strength and large magneto-optic coefficient [18,19]. Cobalt ferrite is a spinel structured materials which is known that the Co^{2+} ions have preference for the B-sites [14]. Cobalt ferrite may be complete inverse spinel or partial inverse spinel depend on cation substitution or heat treatment [16]. The cation distribution between Co^{2+} ions and Fe^{3+} ions over the A-sites and B-sites effect on the physical properties of cobalt ferrite spinel. In cobalt ferrite, the preference of cations is not fixed but cobalt ions show a strong preference for B-sites. The information about cation distribution can be achieved from the peaks of X-rays diagrams [20]. This study focused on the variation of heat treatment (synthesis and high annealing temperature) and a co-precipitation procedure was used to synthesize the cobalt ferrite nanoparticles due to its high simplicity procedure, low cost and good grain size control [21]. The resulting cobalt ferrite nanoparticles were then characterized using FTIR to study their infrared spectra and X-ray diffraction to study their structural properties and cation distribution.

2. RELATED STUDY:

Nowadays, the material called as Nanosized ferrite has gained more interest in the recent decades. It displays an abnormal chemical as

well as physical properties termed to be dissimilar to those of the aggregate materials due to their acutely small measurement and ample specific apparent surface area. Normally, the features of ferrites are said to be non-conductive ferri magnetic bowl compounds acquired from the oxides of iron like hematite (Fe_2O_3) or magnetite (Fe_3O_4) and also the added metal oxides, and are like the best added ceramics, tough and fragile [8]. In conformity with the alluring properties, the diverse ferrites are generally classified as either "elastic" or "rigid", which refers to their low or aerial alluring coercivity. The inorganic compound Zinc oxide is denoted by its formula ZnO . This is impenetrable in water and generally has the appearance of white powder. The powder is broadly acclimated as an accretion into the numerous products and materials involving rubber, glass, ceramic materials and lubricants. Zinc oxide is a vital and imperative material because of its cost effectiveness and ample band gap (3.37 eV), luminescent features and ample excitation binding activity (60 MeV). It is broadly employed in abounding applications like gas sensor, catalyst, filtering properties for UV light, and additionally as retanning and antimicrobial abettor. The black material cupric oxide (CuO) has the melting point above 1200°C , which includes oxygen loss and is utilized as a colorant in adobe glazes. Numerous colors such as blue, red, and green can be acquired from it. As a mineral, it is accepted as tenorite which has the features of organic solvents, water dissolvent and has the color of red. Copper (II) oxide has appliance as a p-type

semiconductor [5]. It is an adapted aggravate to optical equipment brightness for generating dry battery cells as cathode. Cupric oxide (CuO) is an imperative metal oxide transition along with the narrow band gap, and forms the base of several absorbing aerial temperature superconductors and huge magneto resistant materials. Either Iron (III) oxide or Ferric oxide is an inorganic admixture with the chemical formula Fe_2O_3 . It is one of the three imperative iron oxides and the rest is two iron (II) oxide (FeO), which is exceptional and iron (II, III) oxide (Fe_3O_4), which additionally occurs as the magnetite mineral. The mineral accepted as hematite, Fe_2O_3 , is the center antecedent of iron for the purpose of steel industry. The formula Fe_2O_3 has dark reappearance and is voluntarily assailed by acids [2]. The term rust is generally iron (III) oxide, and to some measurement this characterization is functional, because rust shares several luminescent properties with the related composition. The rust is treated as the hydrated ferric oxide and an ill-defined material by chemists. The utilization of the high purity raw materials helps in the preparation of the ferrite sample, because the existence of impurities present in the raw materials may have a great influence on the prepared material properties. Asuitable percentage of the weight of the oxide is required for mixing the diverse composition. The nano powders of ZnO, CuO and Fe_2O_3 are taken and they are mixed in an equal proportion to attain the uniformity among the components [1]. This nano powder preparation can be executed by the sol-gel

method, which is explained in the next section.

3. PROPOSED METHODOLOGY:

The solution was constantly stimulated by utilizing the magnetic agitator by keeping it at the 50 °C in this technique. This combined solution was transferred to a vessel and it was allowed to be heated to 100 °C slowly and stimulated constantly till it remained glutinous, and the color change happened when the solution became a green absorbent dry gel. This type of dry gel was allowed to burn to become a loose powder [7]. A similar technique is involved in preparing copper zinc ferrite by accumulating the hexa hydrated zinc nitrate. This type of powder preparation can be calcined and maintained at various temperatures i.e. 800 °C and 600 °C for about 5 hrs. The samples can be prepared, characterized and synthesized by various techniques like EDAX, XRD, FTIR and SEM.

The same microscope was used to collect the backscattered radiation. The scattering light dispersed was detected by a charge-coupled device (CCD) detection system. Room temperature Raman spectra are in spectral range from 100 to 800 cm^{-1} . The average power density on the sample was 20 $mW\ mm^{-2}$. • The infrared (IR) measurements were carried out with a BOMEM DA-8 FIR spectrometer. A DTGS pyroelectric detector was used to cover the wave number range from 50 to 700 cm^{-1} . • The morphology of powders and the size of soft mechano-synthesized ferrite crystallites were examined by scanning electron

microscopy (SEM, Model TESCAN Vega TS130MM) and transmission electron microscopy (200 kV TEM, Model JEM-2100 UHR, Jeol Inc., Tokyo, Japan). • The Mössbauer spectra of powder samples were measured at room temperature (RT) using a source of ^{57}Co in Rh (1.85 GBq). The experiments were performed in standard transmission geometry with constant acceleration calibrated by the laser spectrum. The data were analyzed by The WinNormos Site program [17]. Sample thickness correction was carried out by transmission integral.

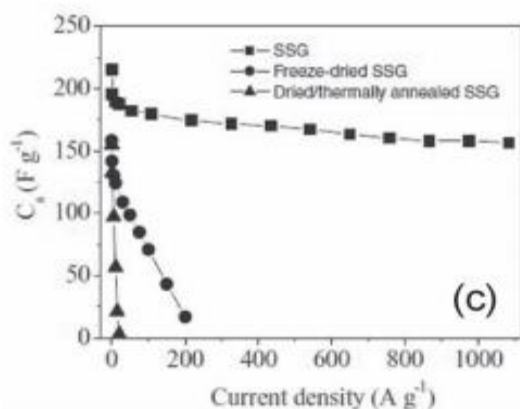


Fig.4.1. Gravimetric capacitances measured at various charge/discharge currents.

5. CONCLUSION:

CoFe_2O_4 nanoparticles were successfully synthesized using co-precipitation method. FTIR result indicated the sample was spinel cobalt ferrite at wave number around 590 cm^{-1} . The crystalline structure was confirmed using x-ray diffraction that the high purity of cobalt ferrite was realized. Calculation of the cation distribution by

using comparison I220/I222 and I422/I222 showed that the synthesis and annealing temperature successfully modification occupation on the tetrahedral and octahedral sites.

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