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Research Article

Characterization Study of Synthetic Iron Oxide nanoparticles at Different Temperature

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Abstract

In the atmosphere, the Iron oxide nanoparticles were synthesized in a method called "solid-state chemical reaction". The resulting powder were characterized by XRD (for 0 C' and 600 C', SEM and EDAX technique). The SEM were used to measure the mean particle sizes of the iron oxide nanoparticles. The resulting effects of the temperature were examine on the particle site and phase formations. The processing of the produced powders of maghemite (ɤ-Fe2O3) was altered to hematite (α-Fe2O3). Furthermore, with the increment of the milling times the iron oxide size decreased.

Keywords: *nanoparticles, Iron oxide, temperature, particle size*

Introduction

Because Super para magnetic iron oxide nanoparticles have unique physical and chemical properties, they are of high interests for a wide and broad range of applications. The chances for the formation of agglomerate for Nanoparticles are insignificant at room temperature and there is almost zero external magnetic field without the magnetization. There are quite a few number of appropriate technologies that have been form to produce magnetic nanoparticles. Micro emulsions (A.H. Lu *et al*, (2007)), electrochemical process (S.M. Zhou *et al* (2010)), Sol.gel synthesis (R. Fan *et al*(2001)), co-precipitation (T. Aubert *et al*(2010)), hydrothermal reactions (J. *Toniolo et al*(2007)) and combustion processes (S. Franger *et al*(2004)). The downside of those ways mentioned is that they need to use very expensive organic precursors as the beginning materials or part particles accumulation during high temperature oxidation in air. Nowadays it is still a huge challenge to develop a convenient, new and large-scale production method. Howsoever, the so-called mechanochemical processing is a method probably the simples and most ecologically clean procedure (H. Karami (2010) and O. Karaagac *et al*(2010)). There is a procedure called "The solid-state chemical reaction method", in which a chemical reaction takes place during the grinding of solid precursors. Here the production of iron oxide nanoparticles were carried out by solid-state chemical reactions method and the impact of the heat treatment of formed phase of iron oxide and it particles site.

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Procedure

To prepare iron oxide nanoparticles, we added the KCl (35 g.) to $FeCl_3$ (16.5 g.) and then mixed this compounds by using the mortar at room temperature for 15 min. and the color for the mixture was black, after 15 min. we added KOH (11 g.) to the mixture. The color of the mixture converted to the orange and during the grinding. We saw the release of a white vapor and increasing in the heat for the mixture, and gradually the vapor was stopped and the color converted to yellow after 30 min. the produced compound was washed with distilled water for many time by using the filtration. By using, the ultrasonic apparatus the produced treated for 20 min. with water for many times. The produced became brown nanoparticles (Maghemite) because is reacted with air. We put the product in the oven with deferent temperature to produce the hematite (α-Fe2O3).

$4FeCl_3 + 8KCl + 9KOH$ ------- > $2Fe_2O_3 + 3H2O+17$ KCl

Results and Discussions

The effect of different temperature was studied as show in figure 2 for x-ray patterns. Which give us a structure of material. According to JCPDS 25-1402 our sample agree with tetragonal structure of Maghemite (ɤ-Feo) at room temperature (because Fe ions are sensitive to oxidation) for pattern characteristic (2 0 3), (1 1 9), (0 0 12), and (2 1 12),(1 1 15) and(4 0 12) peaks for these 2 theta (28.3292,40.4685,50.1903,58.5765,66.3497,73.6778)
When we put our sample in oven at 300 C, 600 C and 800 C for 30 min. The structure of material was transferred at

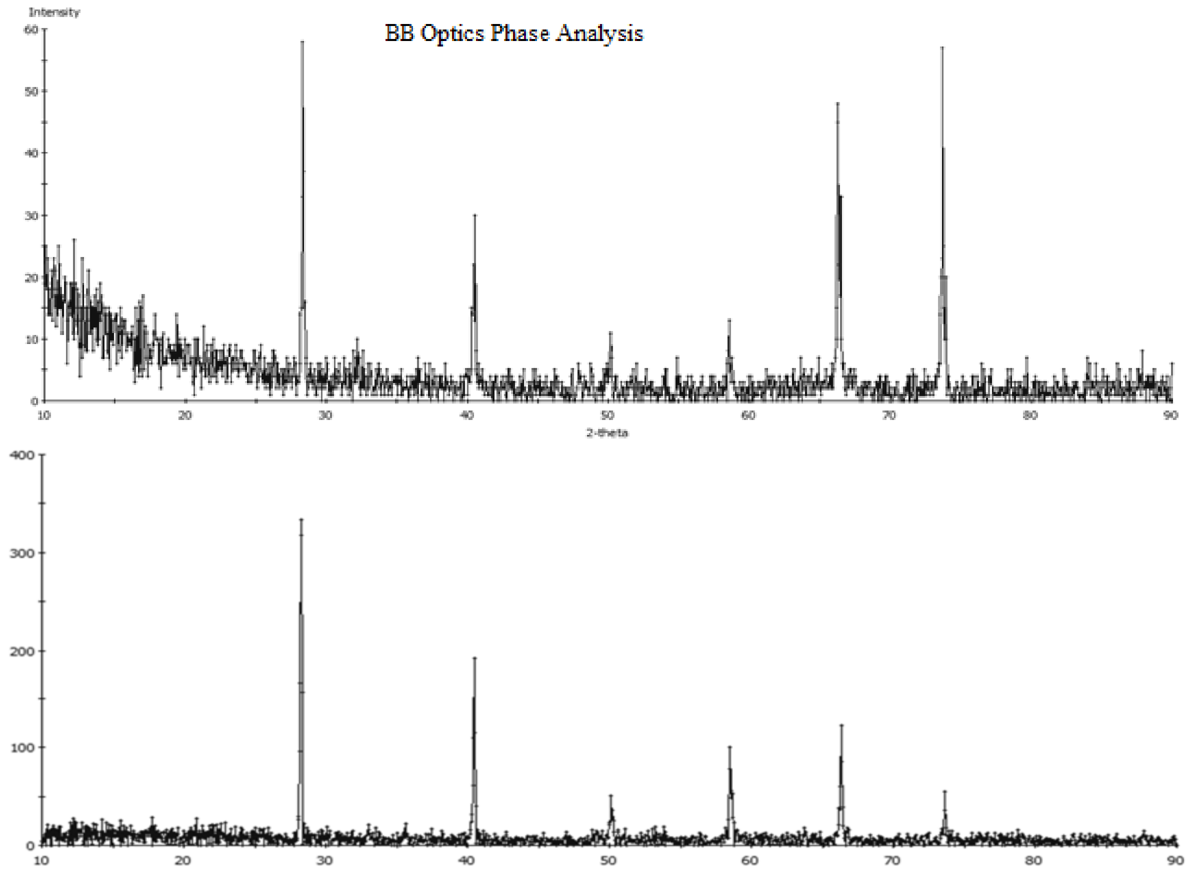

Fig 1 XRD patterns at different temperature

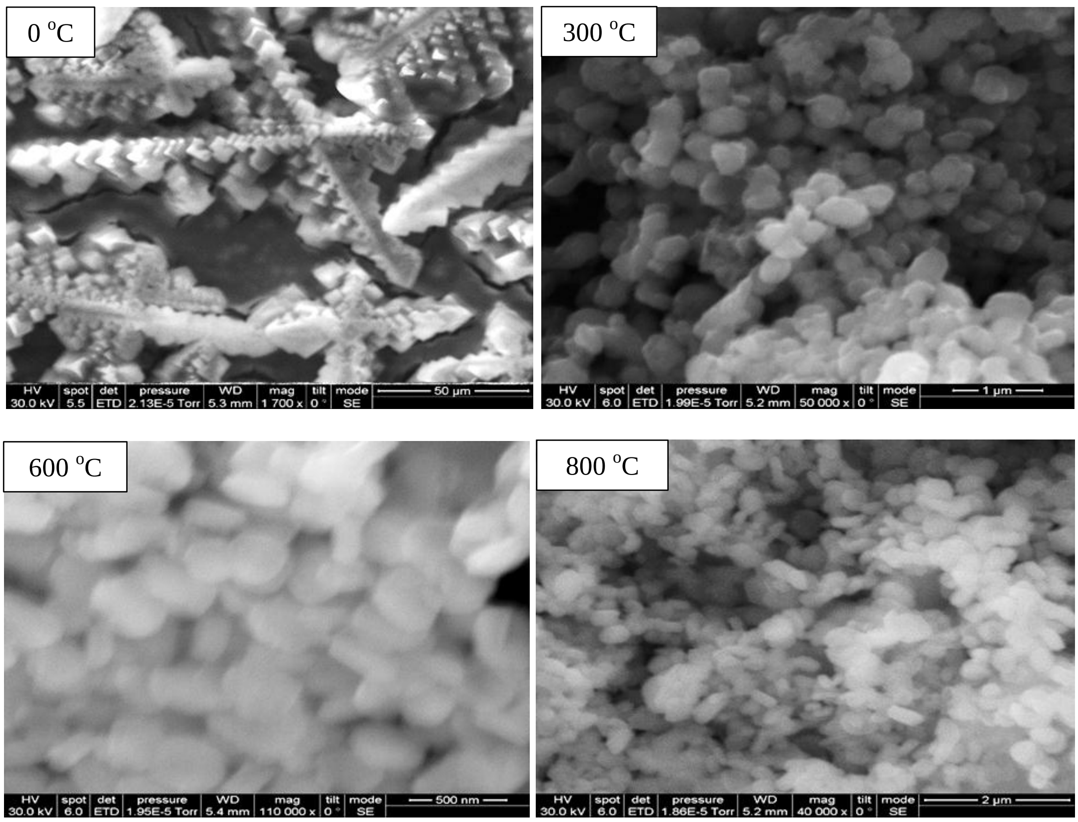

Fig 2 SEM

600 C to hematite (α-Feo) and rhombohedra structure because the diffraction peaks agree with (JCPDS 25-1402) as show in figure (1).

The benefit to add KCL to the reaction is to make a wall surrounding around Fe_2O_3 particles to keep from growing. Kcl is soluble in water.

The mean size for iron oxide nanoparticles was calculated for 0 C (Maghemite) and 600 C (hematite) from the maximum intense peak (2 0 3) by using scherr's equation.

For 0 C (Maghemite) the average particles size were (7.45 nm) but for 600 C (Hematite) the average size was (75 nm) which mean that the particles size was increase with increase temperature, which was agree with SEM Figure(2).

Conclusion

By using this procedure we can prepare nanoparticles. The structure form of Fe_2 O_3 is converted to another form a high temperatures. Particle size increases with increase in temperature.

References

A.H. Lu, E.L. Salabas and F Schüth (2007), Magnetic nanoparticles: synthesis, protection, functionalization, and application, *Angewandte Chemie international Edition,* Vol. 46, No 8, pp.1222-1244.

S.M. Zhou, S.Y. Zhao, L.F. He, Y.Q. Guo, L. Shi (2010), Facile synthesis of Ca-doped manganite nanoparticles by a nonaqueous sol–gel method and their magnetic properties , *Materials Chemistry and Physics,* Vol. 120, Issue 1,pp. 75-78

R. Fan, X.H. Chen, Z. Gui, L. Liu, Z.Y. Chen(2001), A new simple hydrothermal preparation of nanocrystalline magnetite Fe3O4, *Materials research bulletin* ,Vol. 36, issue 3-4, pp. 497-502

T. Aubert, F. Grasset, S. Mornet, E. Duguet, O. Cador, S. Cordier, Y. Molard, V. Demange, M. Mortier, H. Haneda(2010) , Functional silica nanoparticles synthesised by water-in-oil microemulsion processes, *J. Colloid Interface Sci*.Vol. 341,Issue (2), pp. 201-208

J. Toniolo, A. S. Takimi, M. J. Andrade, R. Bonadiman, C. P. Bergmann (2007), Synthesis by the solution combustion process and magnetic properties of iron oxide (Fe3O4 and α-Fe2O3) particles, *Journal of Materials Science* ,Vol. 42,No. 13,pp. 4785-4791.

S. Franger, P. Berthet, and J. Berthon (2004), Electrochemical synthesis of Fe3O4 nanoparticles in alkaline aqueous solutions containing complexing agents,*J. Solid State Electrochem,* Vol. 8,pp. 218-223

H. Karami (2010), Synthesis and Characterization of Iron Oxide Nanoparticles by Solid State Chemical Reaction,Method, *J.Clust Sci* Vol. 21, pp.11-20

O. Karaagac,·H. Kockar,·T. Tanrisever, (2011), Properties of Iron Oxide Nanoparticles Synthesizedat Different emperatures, *J.Supercond Nov Magn*, Vol. 24,pp.675-678