Est. 1984

ORIENTAL JOURNAL OF CHEMISTRY
An International Open Free Access, Peer Reviewed Research Journal
www.orientjchem.org

ISSN: 0970-020 X
CODEN: OJCHEG
2014, Vol. 30, No. (3):
Pg. 1173-1178

Synthesis of Fe_3O_4 N anoparticles from Ironstone from The Republic of Yemen

NABIL ABDULLAH NOMAN ALKADASI

Department of Chemistry, Faculty of Education and Science,
Rada'a, Al-baida'a, University, P.O.Box:39189, Yemen.
*Corresponding authorE-mail: nalkadasi@yahoo.com

http://dx.doi.org/10.13005/ojc/300330

(Received: May 29, 2014; Accepted: July 03, 2014)

ABSTRACT

In this study, a new preparation of Fe_3O_4 nanoparticles is reported. Fe_3O_4 nanoparticle were successfully synthesized . This method consisted of two stages, beginning with the pulverization and separation of iron ore from ironstone by using the coprecipitation method of magnetite. The characterization of Fe_3O_4 nanoparticle was done by TEM ,XRD and U.V.

Key words: Magantite , Fe_3O_4 nanoparticles and properties and characterization.

INTRODUCTION

Recently, a considerable amount of research focused on iron oxides , due to their potential uses in pigments, drug deliverg and resonance imaging for clinical diagnosis, recording material and catalyst, etc[1-3]. The magnetic nanoparticles exhibit superparamagnetic behavior because of the infinitely small coercivity arising from the negligible energy barrier in the hysteresis of the magnetization loop of the particles as predicted[4]. There are many ways to prepare Fe_3O_4 nanoparticles, which have been reported in other papers, such as arc discharge, mechanical grinding, laser ablation, microemulsions, and high temperature decomposition of organic precursors, etc. These methods are used to prepare magnetice nanoparticle with controlled diameters. However, well-dispersed aqueous Fe_3O_4 nanoparticles have been met with very limited success. Several methods have been published for synthesizing Fe_3O_4 nanoparticles, and several research studies have reported the successful preparation of nano- or microscale Fe_3O_4. Using different methods, such as the ultrasonic chemical coprecipitation method and the solvothermal method[2-6] have been for reported the synthesis of nanoparticle Fe_3O_4 in organic solvent, and Cupper[7] successfully fabricated magnetic Fe_3O_4 covered with a modifiable phospholipid coating . Of these methods, chemical coprecipitation was reported to be the most promising because of its simplicity and productivity[8-10]. The physics of nanoscale magnetic materials has been a vivid subject for researchers within the last few decades and the exploration of iron sand from beaches or rivers to prepare magnetic materials on nanoscale has been reported in some studies[11]. In this paper, magnetic materials from ironstone mining in Pasaman Barat West Sumatera were investigated, and it was found that ironstone in that area contained 12.462 ppm of iron (Fe), with a susceptibility magnetic value of 888.81 x 10-8 m3/kg by using an atomic absorption spectrophotometer and magnetic susceptibility meter.For these reasons, these materials have the potential to be developed and cultivated as raw materials for magnetite (Fe_3O_4). Although there have been many significant developments in the synthesis of magnetic nanoparticles, the stability of these particles without agglomeration or precipitation is an important issue. It began with the crushing of ironstone into powder form and then synthesizing Fe_3O_4 nanoparticles by using the coprecipitation method of magnetite ore .

EXPERIMENTAL

Materials

Hydrochloric Acid (HCl) and Ammonia Solution (NH_4OH) were purchased from Sinopharm chemical reagent Co ,Ltd ,China,and ironstone was obtained from Republic of Yemen.

Physical parameters of Hydrochloric Acid (HCl), Ammonia Solution (NH_4OH) and Fe_3O_4 powder are reported in table 1 , 2 and 3 respectively.

Experiment

Two steps of prepararing samples have been reported here . In the first step ironstone was pulverized to obtain a powder . Then a permanent magnet was used to obtain the iron ore.In the second step the iron ore powders were prepared by the chemical coprecitation method.

In typical coprecipitation synthesis procedure , 10 g Fe_3O_4 powder and 20 ml HCl were mixed and heated at 90 ^{0}C for one hour . The solutions were filtered and then 25 ml NH4OH (90%) was added to the filtrate .The black precipitate was collected and washed with de-ionized water and pure ethanol three times.

Transmission Electron Microscope (TEM) Test

For TEM Test , a small amount of sample was dissolved in 3mL of deionized water in test tube and the solution was stirred by ultra-sonication. Then 10 µ L sample was transferred to clean Copper Grid and kept for drying for TEM test.The TEM micrographs of samples were observed by CM 12 Philips Transmission Electron Microscope .

RESULTS AND DISCUSSION

The Fe_3O_4 nanoparticle was synthesized by heating to 90 ^{0}C of Fe_3O_4 powder . plate 1,2,3 ,4,5,6and 7 (TEM) shows the top-view TEM images of the Fe_3O_4 Nanoparticle plate (TEM) 1 The size of the Fe_3O_4 nanoparticle is clear from the TEM. The surface of Fe_3O_4 nanoparticle shows several large meandering wrinkles. The size of Fe_3O_4

Table 1: General Characteristics of Hydrochloric Acid (HCl)

Molecular formula	Hydrochloric Acid (HCl)
Appearance	liquid
Molecular weight	36 .5
Concentration	36 – 38 %
Company	Sinopharm chemical reagent Co ,Ltd ,China

Table 2: General Characteristics of Ammonia Solution (NH_4OH)

Molecular formula	Ammonia (NH_4OH)
Appearance	liquid
Molecular weight	17.03
Concentration	25 – 28 %
Company	Sinopharm chemical reagent Co, Ltd, China

Table 3: General Characteristics of Fe_3O_4 powder

Molecular formula	Magentite oxide powder (Fe_2O_3)
Appearance	Brown powder
Fe_3O_4 %	45.31-75
Chorite	37.73-13
Riebeckite	16.95-15
Country	Al-Baida'a ,Yemen.

Photo.1 : Fe_3O_4 Rock **Fe_3O_4 in powder form**

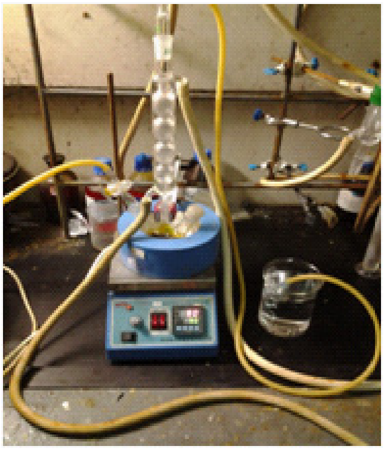

Photo 2 : Equipment **Fe_3O_4 Nanoparticle (after dry)**

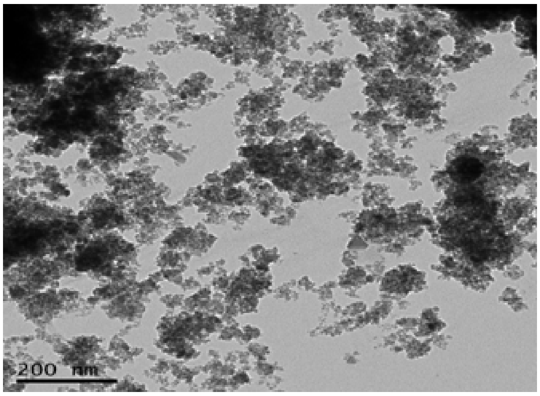

Plate 1: Fe_3O_4 nanoparticle

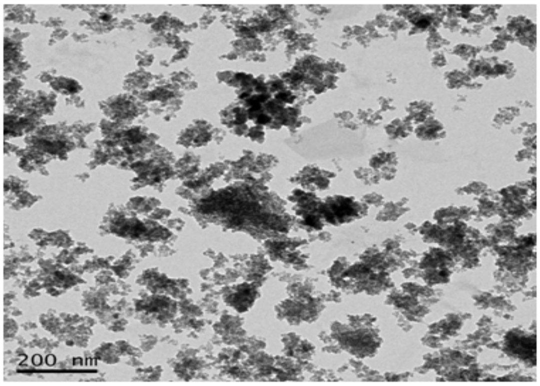

Plate 2: Fe_3O_4 nanoparticle

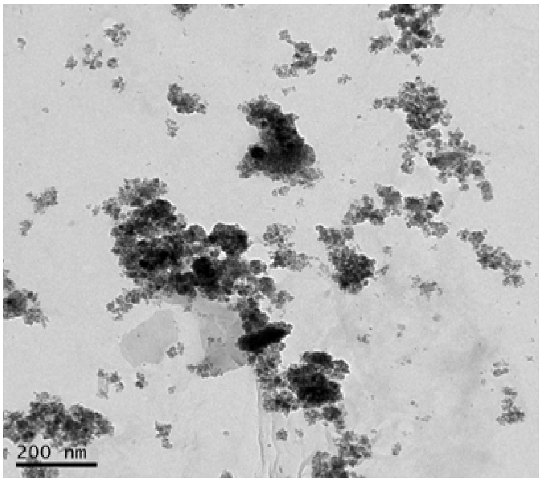

Plate 3: Fe_3O_4 nanoparticle

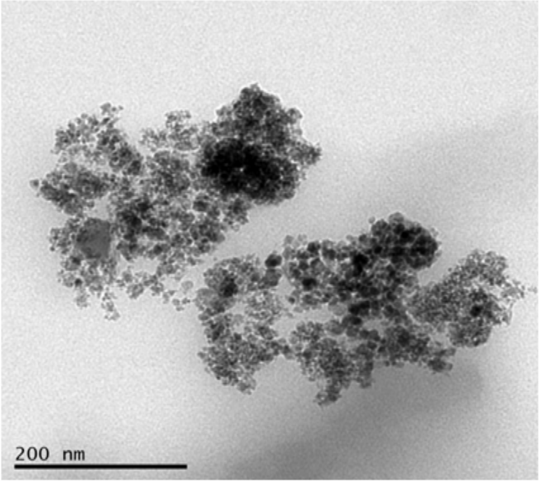

Plate 4: Fe_3O_4 nanoparticle

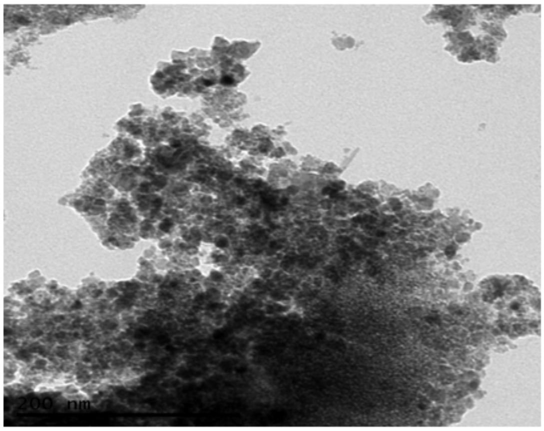

Plate 5: Fe_3O_4 nanoparticle

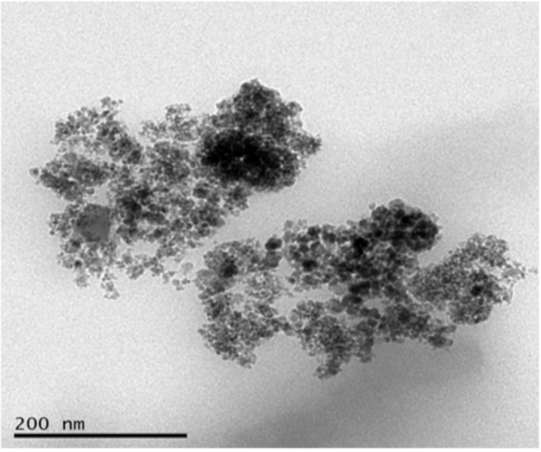

Plate 6: Fe_3O_4 nanoparticle

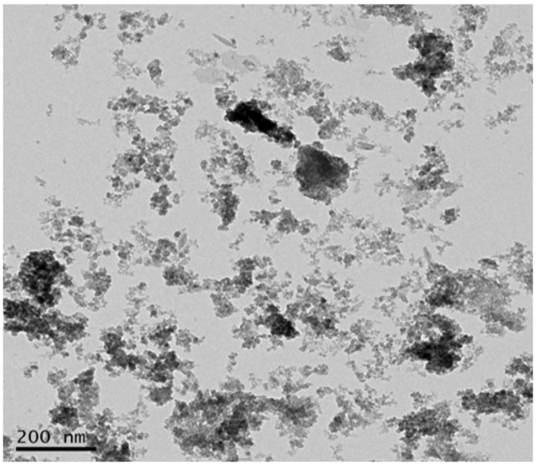

Plate 7: Fe_3O_4 nanoparticle

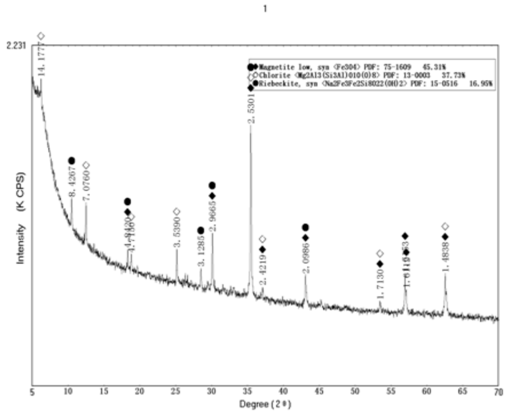

Fig. 1: XRD for Fe_3O_4 Iron Powder

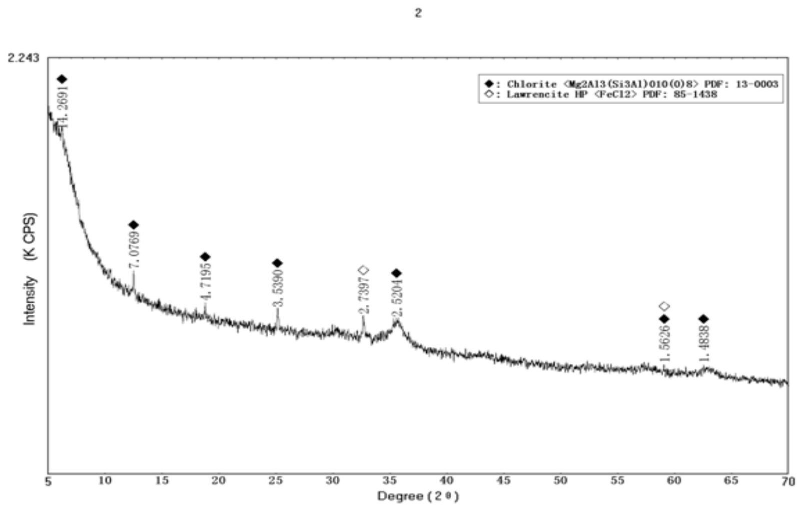

Fig. 2: Fe_3O_4 nanoparticle

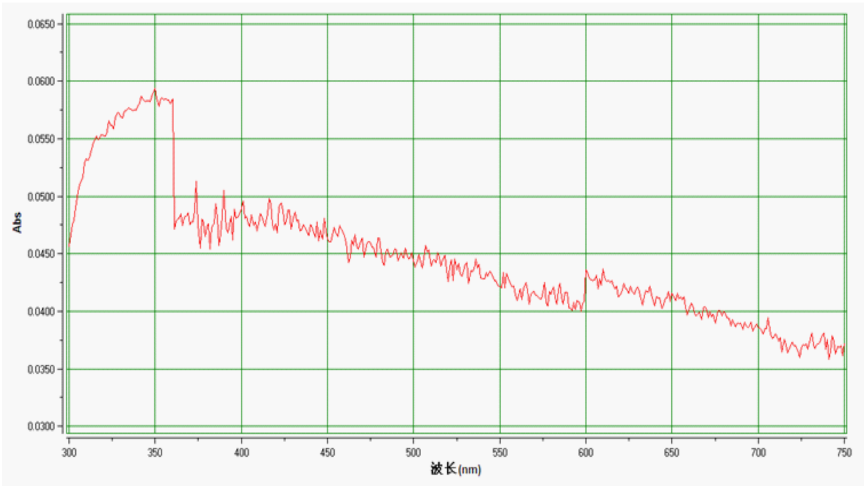

Fig. 3: Magnetite

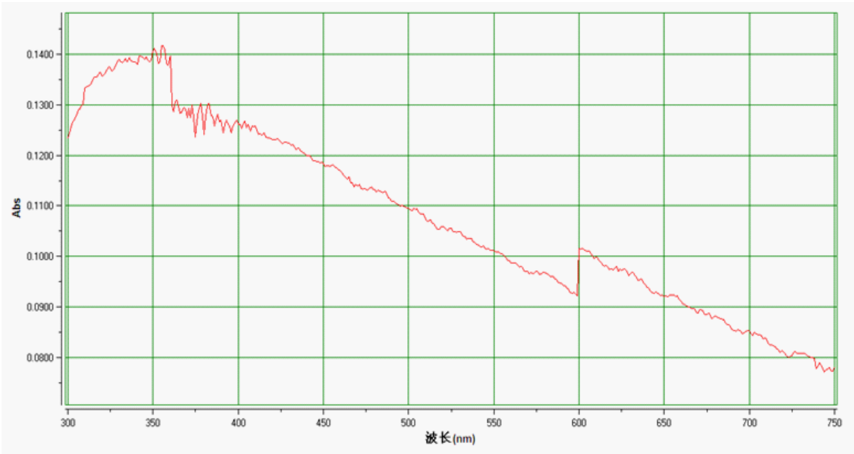

Fig. 4: Fe_3O_4 nanoparticle

nanoparticle can be clear from TEM image . Fig (1and 2) X-ray differaction shown the graph all of Magnitite and Fe_3O_4 nanoparticle. Fig (3and 4) U.V shown the graph all of Magnitite and Fe_3O_4 nanoparticle respectively dispersed in chloroform.

REFERENCES

1. Astuti, G.Claudia, Noraida, and M.Ramadhani, *Makara J. Sci,* August **2013,** *17(2)*.
2. P. Tartaj, M.P. Morales, S.V-Verdaguer, T. GCarreno,C.J. Serna, *J. Phys. D: Appl. Phys.* **2003**, *36***,** R182.
3. S. Wu, S. Aizhi, Z. Fuqiang, J. Wang, X. Wenhuan, Z. Qian, A.A. Volinsky. *J. Mater. Lett.* **2011**, *65*, 1882.
4. S. Bedanta. Dissertation, Universitat Duisburg, Essens, **2006**.
5. A. Yan, X. Liu, G. Qiu, H. Wu, R. Yi, N. Zhang, J. Xu, *J. Alloy. Compd.* **2008**, *458/*1-2, 487.
6. Z. Yuanbi, Q. Zumin, H. Jiaying, *Chinese J. Chem.Eng.* **2008**, *16/3*, 451.
7. H.T. Hai, H. Kura, M. Takahashi, T. Ogawa. *J. Colloid Interface Sci.* **2010**, *341*, 194.
8. M.D. Cuyper, P. Müller, H. Lueken, M. Hodenius, *J. Phys: Condens. Matter.* **2003,** *15*, S1425.
9. H.E. Ghandoor, H.M. Zidan, Mostafa, M.H. Khalil, M.I.M. Ismail, *Int. J. Electrochem. Sci.* **2012**, *7*, 5734.
10. S. Mendoza, R.A. Morales, L. Flores, J.P. Hinestroza, V.S. Mendieta. *J. Nanopart. Res.* **2012**, *14***,** 1242.
11. W. Jiang, H.C. Yang, S.Y. Yang, H.E. Horng, J.C. Hung, Y.C. Chen, C.Y. Hong, J. Magn. Magn. Mater. **2004**, *283*, 210.
12. T. Rusianto, M.W. Wildan, K. Abraha, Kusmono, J. Teknologi. **2012**, *5/1*, 62.
13. P. Hu, S. Zhang, H. Wang, D. Pan, J. Tian, Z. Tang, A.A. Volinsky, *J. Alloy. Compd.* **2011,** *509*, 2316.
14. Y. Hou, Z. Xu, S. Sun, *Angew. Chem. Int. Ed.* **2007**, *46***,** 6329 .
15. S.Y. Zhao, D.K. Lee, C.W. Kim, H.G. Cha, Y.H. Kim, Y.S. Kang, *Korean Chem. Soc.* **2006**; *27/2*, 237.
16. C.R. Lin, T.C. Tsai, M. Chung, S.Z. Lu. *J. Appl. Phys.* **2009**, *105*, 07B509.
17. O. Rahman, S.C. Mohapatra, S. Ahmad, *J. Mater. Chem. Phys.* **2012**, *132*, 196.
18. L.L. Wang, J.S. Jiang, *Nanoscale Res. Lett.* **2009**, *4***,** 1439.
19. S.P. Gubin, Y.A. Koksharov, G.B. Khomutov, G.Y. Yurkov, *Russ. Chem. Rev.* **2005,** *74(6),* 489.
20. R. Nowosielski, *J. Achievements Mater. Manuf. Eng.* **2007**, *24(1)*, 68.
21. F. Schuth, A.H. Lu, E.L. Salabas, *Angew. Chem. Int. Ed.* **2007,** *46(8)*, 1222.
22. J.S. Val, J. González, In: A. Méndez-Vilas, J. Díaz (Eds.), Microscopy: Science, Technology, Applications and Education, Microscopy Book Series no.4, vol. 3, Formatex Research Center, Badajoz, Spain, **2010**, 1620.