Research Paper

e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.9, Dec 2022

Analysis Of Optical, Structural And Magnetic Properties Of Nonmaterials - Using Chemical Method

[1]Kodhandapani E [2]Anandhi Sarangapani

Department of physics

Faculty of Arts & Science
Bharath Institute of Higher Education and Research
Chennai India -600 073
[1]Kothandan.edu@gmail.com [2]Ananthi.Physics@bharathuniv.ac.in
Address for Correspondence

[1]Kodhandapani E [2]Anandhi Sarangapani

Department of physics

Faculty of Arts & Science
Bharath Institute of Higher Education and Research
Chennai India -600 073
[1]Kothandan.edu@gmail.com [2]Ananthi.Physics@bharathuniv.ac.in

Abstract

At Currently, manganese oxide nanoparticles (MnO_2 NPs) have intrigued material science researches XRD widely owing to its extensive variety of applications. In view of the study, the manganeseoxide nanomaterials were prepared via using manganese chloride Tetra hydrates salts. This samples were considered to novelty the structural, functional andmagnetic properties by XRD, VSM, and UV correspondingly. An attempt is finishedtowardreview thecomplete field dependent magnetization study of the synthesized material is presented. Structural studies by XRDindicate that the synthesized material as tetragonal crystal structure. The Antiferro magnetic behavior was detected at room temperature with no saturation magnetization and hysteresis in the region of measured field strength. These dimensions as a role of temperature and field strength showed a reduction in Anferromagnetic temperature.The UV exhibits theprepared manganese oxide were nanoparticles in the wave number ranges of 391.73cm^{-1}.

Keywords: *Nanoparticles; Manganese oxide; Metal oxide; Transition metal oxide,UV,,VSM*

e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.9, Dec 2022

INTRODUCTION

A nanomaterial is defined as any item with at least one dimension on the nanoscale scale.Nanomaterials are categorized according to their dimensions. Metal oxides have piqued material scientists' interest owing to an optical, electrical, thermal, magnetic, mechanical, and catalytic properties, which type them scientifically and technically important. Metal oxide nanostructures have recently received a lot of interest because of their potential use as functional components for nanoelectronics, optoelectronics, and sensing devices with an electronic structure. They may be metallic, semiconducting, or insulating in nature.Oxides can also be utilised to create microelectronic circuits, sensors, piezoelectric devices, fuel cells, corrosion-resistant surface coatings, and other devices. It is essential to understand the link among the properties and structure (both physical and chemical) of oxide materials, as well as the applications. Many important applications for metal oxides such as iron, nickel, cobalt, manganese, copper, and zinc have been studied, including magnetic storage media, solar energy transformation, electronics, semiconductors, and catalysis [**Vijayamari .,2016**]. Current findings on oxidematerials reveals the majority of tephysico-chemical properties are strongly dimension dependent. Oxide's physicochemical properties are typically connected with industrial uses such as sensors, ceramics, absorbents, and/or catalysts. A variety of novel applications in these fields are based on the size-dependence of oxide nanomaterials' optical, (electronic and/or ionic) transport, mechanical, and, of course, surface/chemical (redox, acid/base) properties.It is crucial to note that size effects in oxides often have two connected faces, the structural/electronic quantum influence of these two phenomena in the primary physicochemical properties of oxides. The qualities of MMO nanoparticles are mostly size dependent, and their chemical and physical properties differ from those of similar majority materials. Manganeseoxidesis one of the most common minerals on the world and they may be found in a wide range of natural sediments, soils, and ores. They're also in desert rock varnish and marine manganese oxides [Achurra 2009]. There are many naturally occurring crystalline manganese oxides with close MnO2 stoichiometry, as well as several amorphous manganese oxides [Achurra2009, Luo 2008, Nitta1984, and Cao 2010.,]. Furthermore, crystalline material architectures are mostly composed of edge-shared MnO6 octahedral units that are organised to resemble tunnelled, layered structures.MnO contributes to the high porosity and surface areas of the material's structure.

e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.9, Dec 2022

These MnO nanoparticles are significant due to their distinct characteristics, which include a high surface-to-volume ratio, high crystallinity, chemical purity, and phase selectivity when compared to their bulk equivalent. It has been observed that the physical and chemical characteristics of a substance are related to its stoichiometry, particle size, and shape. MnO2, Mn3O4 nanoparticles have the potential to be utilised in a variety of applications, including electrodes [Lind1988], catalysis [Xi, 2004], sensors [Li., 1997], and optoelectronics [Shchukin., 2007].

Experimental

MATERIALS

Chemicals

Manganese Chloride hexa chloride [$Mn(Cl_2)_2.6H_2O$], the precursor for Manganese, Sodium hydroxide (NaOH), the oxide source, Ethanol, Deionized Water were purchased from Merck. Because the chemicals were of analytical regent grade with 99 percent purity, they were utilised exactly as received.

Methods - Synthesis of Manganese Oxide NPs .

For the production of nanosized MnO2 precursors, 1M of Manganese chloride (MnCl2) in 100ml of deionized water and 0.66 M in 100ml of NaOH were combined and rapidly stirred at 30oC. After 8 hours of stirring, a brown precipitate of MnO2 precursor was produced. To eliminate contaminants, the obtained precursor was cleaned with distilled (Deionized) water and ethanol alternately. Todget the nano-sized powder of precursor MnO2, the washed product was kept at 80°C in a hot air oven. The precursor was annealed at 500°C for 4 hours to get the pure phase of MnO2 and to make nano-sized MnO2 particles.

e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.9, Dec 2022

Co-precipitate method

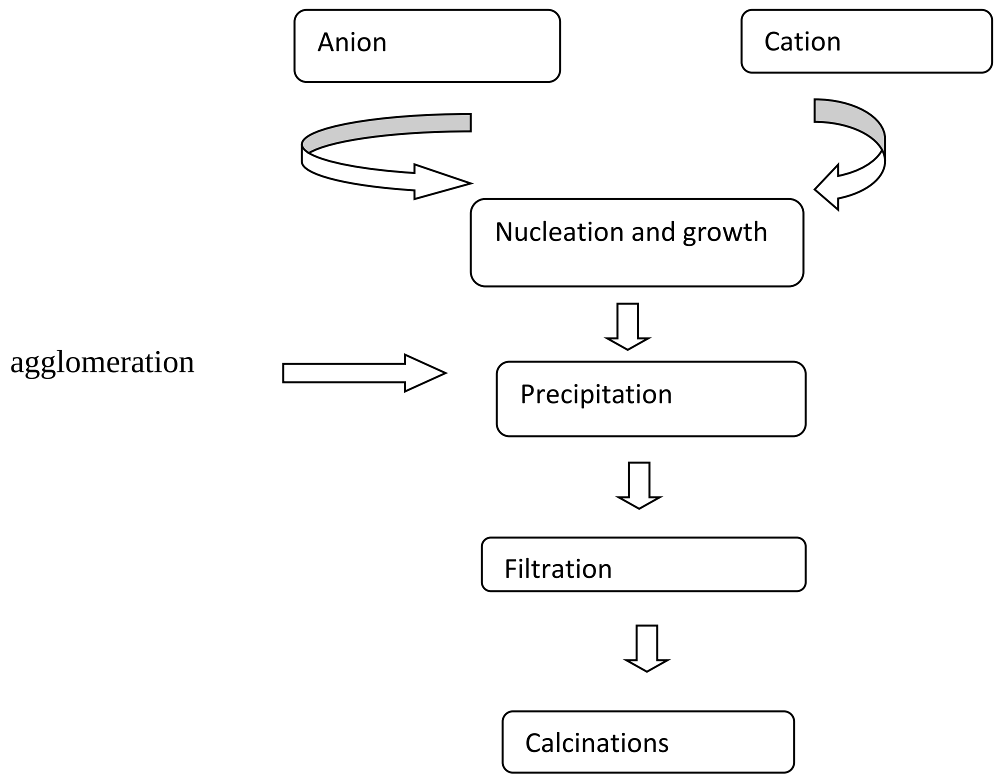


Fig 3.1 photo image of typical Mn-O2 preparation process

RESULTS AND DISCUSSIONS

X-Ray Diffraction pattern of manganese oxide nanopowder

The XRD particle diffraction patterns (fig.3.2) show the development of a Nanocrystalline product that is compatible with the spinal structure of Mn2O nanoparticles. As shown in Fig.3.1, the XRD pattern is utilised to identify the phase and purity of the produced MnO2 nanoparticles. The diffraction peak locations are acquired using an XRD diffract meter at the values of 18.1°, 29°, 32.4°, 36.2°, and 60°, which correspond to the crystal planes (101), (112), (103), (211), and (224), respectively. All of the distinctive diffraction peaks are properly indexed to and agree with the previously reported tetragonal structure of MnO2 single phase (JCPDS card no. 24-0734). (Vazques-olmos 2005, America.)

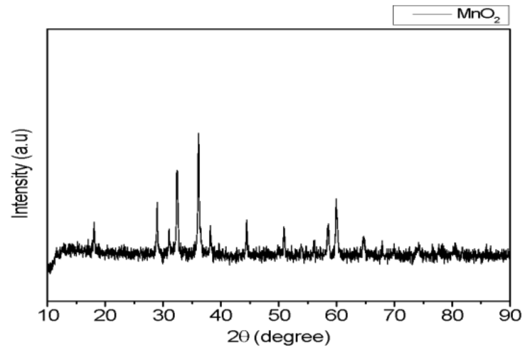
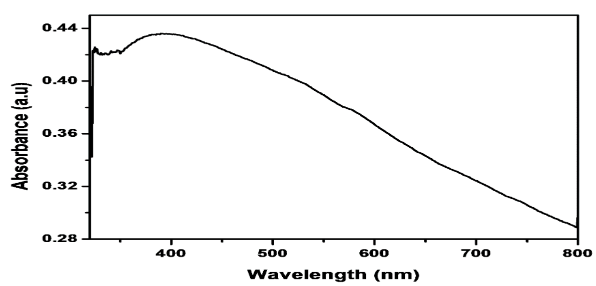


Fig.3.2 shows the XRD pattern of the annealedmanganese dioxide nonamaterial

UV-SPECTROSCOPY - Optical properties

The method of ultra-visible spectroscopy is used to quantify the amount of light absorbed and dispersed by a material. Figure 3.3 depicts the UV–Vis absorption spectra of a sample Manganese oxide nanoparticles. The optical absorption coefficient is calculated for wavelengths ranging from 200 to 600 nm. Furthermore, the manganese oxide samples' transparency could be detected at higher wavelengths, and the absorption band boundaries are predicted to be approximately 391.71 nm.In general, fundamental absorption from the valence band to the conduction band leads to an optical transition of electrons and may be utilised to determine the type and magnitude of the optical band gap Eg of nanoparticles owing to direct allowed



transition [sagadevan, 2016].

Magnetic behavior of MnO_2

Figure 1 depicts the M-H curve of MnO2 nanoparticles at room temperature. It exposes the behaviour of ferromagnetic and antiferromagnetic materials. The ferromagnetic ordering in

e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.9, Dec 2022

MnO2 may be induced by Mn vacancy.The measured M-H curve of MnO2 indicates that magnetization in the low field area tends to saturate, but magnetization in the high field zone clearly displays unsaturated open linearity. The saturating component is connected to the particle core's uncompensated moment, whereas the non-saturating part is related to the spins of the disordered surface. The values of remanent magnetization and coercivity of $MnO_2$are listed in Table 3.2.

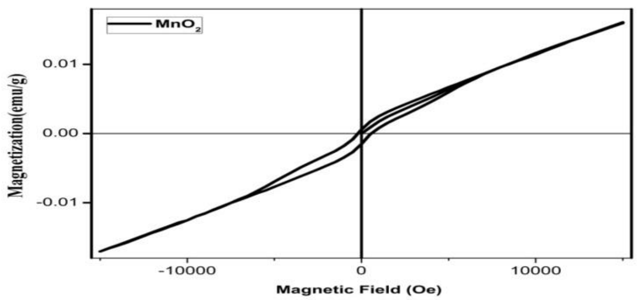


Table:1 Magnetization values of MnO_2

S.No	Remanent Magnetization (M_r x 10^{-3}) inemu/g	Coercivity (H_{ci}) Oe
MnO_2	1.047	380

CONCLUSION

The present study demonstrates the effect of the structural,magnetic properties, microstructural and elemental analysis of Mn_2O nanostructures prepared through a simple chemical precipitation method. Additionally, the products annealed at 500°C were analyzed for their structural, functional and magnetic properties analyzed. The XRD patterns revealed that the particles exhibit a pure cubic structure. Simple chemical method has been used to successfully prepare MnO2nanoparticles, which are indexed as tetragonal Pyrolusite.The nanoparticles were estimated to be between 20 and 30 nm in size. The Antiferro magnetic natures` wasobserved through the room temperature with there is no saturation magnetization as followed by hysteresis in the section of measured field strength. In these measurements as a purpose of temperature and field strength displayed a reduction trendy.Anferromagnetic temperature..UV exhibits the prepared manganese oxide were nanoparticles in the wavenumber ranges of 391.73cm-1. Such magnetic properties hint at several interesting prospects for future studies. This chemical route can be considered as an economical and facile approach to prepare d Manganese oxide nanoparticle.

References

1. Bhushan, B "Handbook of Nanotechnology", publisher Springer, 1-5 **(2010).**
2. Wang, J., M. Lin,Y. Yan, Z. Wang, P.C. Ho, K.P. Loh, "CdSe/AsS Core-Shell Quantum Dots: Preparation and Two-Photon Fluorescence," J. Am. Chem. Soc., 131,11300-11301, (**2009).**
3. Kim, Y.T., J.H. Han, B.H. Hong, Y.U. Kwon, "Electrochemical synthesis of Cd-Se quantum-dot arrays on Graphene basal plane using mesoporous silica thin-film templates," Adv. Mater., 22, 515-518, **(2010).**
4. Wang, Y., Q.Z. Qin, "A Nanocrystalline NiO Thin-Film Electrode Prepared by Pulsed Laser Ablation for Li-Ion Batteries," J. Electrochem. Soc. 149(7), A873-A87, **(2002).**
5. Compagnini, G., A.A. Scalisi, O. Puglisi, "Production of gold nanoparticles by laser ablation in liquid alkanes," J. Appl. Phys. 94, 7874-7877, **(2003).**
6. Dahl, J.A., B.L.S. Maddux, J.E. Hutchison, "Toward Greener Nano synthesis", Chem. Rev. 107, 2228-2269, (**2007).**
7. Shah, M.A., T. Ahmad, "Principles of Nanoscience and Nanotechnology", Narosa Publishing House, 32-65, (**2010**).
8. Jadhav, A.P., C.W. Kim, H.G. Cha, A.U. Pawar, N.A. Jadhav, U. Pal, Y.S. Kang, "Effect of Different Surfactants on the Size Control and Optical Properties of $Y_2O_3:Eu^{3+}$ Nanoparticles Prepared by Coprecipitation Method," J. Phys. Chem. C.113, 13600–13604 **(2009).**
9. Kim, Y.T., J.H. Han, B.H. Hong, Y.U. Kwon, "Electrochemical synthesis of Cd-Se quantum-dot arrays on Graphene basal plane using mesoporous silica thin-film templates," Adv. Mater., 22, 515-518, **(2010).**

e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.9, Dec 2022

10. Hankache, J. & Wenger, O.S. "Organic Mixed Valence",*Chem. Rev.* 111, 5138-5178 **(2011)**.
11. Young, C.G., **(1989)** "Mixed-valence compounds of the early transition-metals"*Coordination Chemistry Reviews.*, 96, 89-251.
12. Varma, C.M "Mixed-valence compounds",*Reviews of Modern Physics.*, 48, 219-238., **(1976).**
13. L.E. Foster, "Nanotechnology", Personal Education, New Delhi, (2006) 143-145.
14. L. Ren, Y.P. Zeng, D. Jiang, Solid State Sci. 12, 138–143., **(2010).**
15. G.Q. Zhang, N. Chang, D.Q. Han, A.Q. Zhou, X.H. Xu, Mater. Lett. 64, 2135–2137.,**(2010)**.
16. Latha Kumari, W.Z. Li, Charles H. Vannoy, Roger M. Leblanc, D.Z. Wang, Ceram. Int. 35, 3355–3364.,**(2009)**.
17. T. Selvamani, T. Yagyu, S. Kawasaki, I. Mukhopadhyay, Catal. Commun. 11(2010) 537–541
18. S.M. Borghei, S. Kamali, M.H. Shakib, A. Bazrafshan, M.J. Ghoranneviss, J. Fusion Energy 30, 433–436.,**(2011)**.
19. J. Liu, L. Meng, Z. Fei, P.J. Dyson, X. Jing, X. Liu, MnO2 nanosheets as an artificial enzyme to mimic oxidase for rapid and sensitive detection of glutathione. Biosens. Bioelectron. 90, 69 (2017)
20. Y. Zhang, Y. Li, C. Zhang, Q. Zhang, X. Huang, M. Yang, S.A. Shahzad, K.K.W. Lo, C. Yu, S. Jiang, Fluorescence turnon detection of alkaline phosphatase activity based on controlled release of PEI-capped Cu nanoclusters from MnO2 nanosheets. Anal. Bioanal. Chem. 409, 4771 (2017)
21. . Makovec, M. Drofenik, A. Znidarsic, J. Eur. Ceram. Soc. 21 (2001) 1945.
22. R. Ramachandran, J. Mater. Sci.: Mater. Electron. 13 (2003) 257.
23. M. Drofenik, A. Žnidarši˘c, M. Kristl, A. Košak, D. Makovec, J. Mater.Sci. 38 (2003) 3063.
24. S. Fritsch, J. Sarrias, A. Rousset, G.U. Kulkarni, Mater. Res. Bull. 33(1998) 1185.
25. O.Y. Gorbenko, I.E. Graboy, V.A. Amelichev, A.A. Bosak, A.R. Kaul,B. Güttler, V.L. Svetchnikov, H.W. Zandbergen, Solid State Commun.124 (2002) 15.
26. V. Berbenni, V. Marini, Mater. Res. Bull. 38 (2003) 1859.
27. J.M. Boyero, E.L. Fernández, J.M. Gallardo-Amores, R.C. Ruano,, V.E. Sánchez, E.B. Pérez,

Int. J. Inorg. Mater. 3 (2001) 889.

28. F.A. Al Sagheer, M.A. Hasan, L. Pasupulety, M.I. Kaki, J. Mater. Sc Lett. 18 (1999) 209.
29. E.R. Stobbe, B.A. de Boer, J.W. Geus, Catal. Today 47 (1999) 161.