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Research Paper

Fabrication of Manganese oxide nanoparticles using simple chemical route

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Abstract

In latest years, Manganeseoxide nanoparticles (MnO_2 NPs) have intrigued material science research are widely owing an extensive variety of application. In this study, the roll of metal precursor in the production of Manganese Oxide nanoparticle has been studied. The manganese oxide nanoparticles were prepared by using manganese chloride hexhydrates salts. To get samples and characterization studied through X-ray diffraction (XRD), UV-visble absorbance HR-SEM and Elemental analysis spectroscopy (EDAX). The XRD indicates that the prepared nanoparticles are crystalline in nature with tetragonal structure. UV exhibits the prepared manganese oxide were nanoparticles in the wavenumber ranges of 391.73cm^{-1}.The HR SEM images revealed typical 2Ddeposit sheet-like morphologies with multiple folds for non-intercalated MnO2 whereas intercalated MnO2 showed more flattered and planar shaped.

Keywords: *Nanoparticles; Manganese oxide; Metal oxide; Transition metal oxide,XRD,HR-SEM*

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INTRODUCTION

In current part, nanomaterials in the nanoscale have consumed ample space among the researchers owing to peculiar properties of physical and chemical than the bulk counterpart. The nanoscale is usuallyspecified as 1-100 nm, An additional excellent of nanomaterials properties is that it can be invented particle via particle, by a development termed as bottom up and lastly nanomaterials have an enlarged outward the capacity related to majority. This higher surface to amount of materials permits using fewer substantial, it is ecologically and economiclly profits as followed as making extremely miniaturiz ans, which can be transportable and it is essentially very less power to activate.In the previous dual periods, universally, efforts in mutually the theoretically then the experimentally growth of study, classification and applications its inorganic nanostructures with metallicoxides, porcelains and mixtures consume result in a grown-up, multidisciplinary field. Nanostructured substances are mentioned for the constancy, green chemistry with discovery various technological and scientific application [Bhushan *et al.*,(2010)]. A rising the major charge accumulation then outward dominant properties, nano-structure metal oxides could effectively substitute totally bulkmetal oxides applicatiosn like catalysis, solar cell and hydrogen storage batteries, electrical etc., [Wang *et al.*, 2009, Kim *et al.*,(2010)]. Manganeseoxides are approximately of plentiful minerals on ground, it is generally found in normal soils, ores and so on. In this phenomenon in developments viz desert rock varnish and seashore area manganeseoxides [Achurra 2009]. There are over three doze naturally-occupying manganese oxide -crystalline with approximation of MnO2and is the formation of many amorphous nature [Achurra 2009, Luo 2008, Nitta 1984, and Cao 2010.,]. Further, the designs of crystalline substances are also comprised mainly of edge-shared MnO_6 octahedral units which are arranged to appearance of tunneled or layered structures. MnO is donating the high porosity and surface areas of structure of the materials.

Among these MnO having many potential applications in almost all the areas covered with industrial and commercial purposes. Oxides of Manganese(MnO) is considered the strongest natural oxidant agent and it can be found in an extensive range of natural environments and oxidation states like Mn(II), Mn(III), and Mn(IV) and is related to their oxidation state, crystalline phase, and surface area [Vicentede Oliveira Sousa Neto 2019].MnO has properties in catalystic, toxic misuse remediation, as additives in refractory, paint and superconductor products and steel developed because its high corrosion-resistant behaviour [Kumari et al., 2009]. Mn is a great research interest of

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MnOxide nanoparticles due to the potential applications such as electronic, optical and mechanical devices based on the variation oxidations states. Dissimilar techniques are create the metal oxide nanopowder but reported procedures have limited mange of the particle functionality [Lind., 1988].

All chemicals used were of analytical grade and were commercially obtained. 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 E-Merck , India. Because the chemicals were of analytical regent grade with 99 percent purity, they were utilised exactly as received.

Synthesis of Manganese Oxide NPs .

At room temperature, a manganese oxide nanoparticle was created through a simplechemicalprecipitativeprocedure. In this study, asynthesis process for 0.2M MnCl2 was thoroughly documented. In 100 ml of distilled water containing 0.44 g of NaOH aqueous solution, 4H2O was dissolved. With continual stirring, 25 mg of trisodiumcitrate was added as a surfactant, which can prevent nanoparticle reunion. After 24 hours of stirring, a brown colour precipitate was produced, indicating that the reaction had completed. The precipitate produced is filtered, cleaned several times throughDeionised water as well as ethanol with dried overnight in a hot air oven at about 80 °C. The surfactant Trisodium citrate was removed by calcining the as-prepared sample at 500 °C for four hours below air at a ramping rate of 5°C min-1.

RESULTS AND DISCUSSIONS

XRD- 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 metre 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. In view 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-

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olmos 2005, America.)

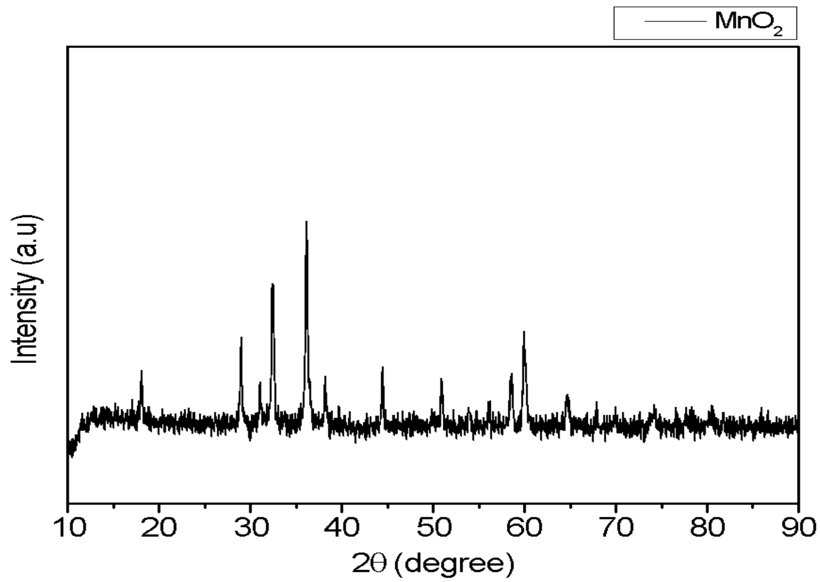

Fig.3.2 : XRD pattern of the annealed under500degreeC for 3 hours manganese dioxide nanocrystal powder

UV-SPECTROSCOPY -

The method of ultra-visible spectroscopy is an amount of light absorbed and distributed via a material. Fig.3.3 depicts the UV–Vi absorption spectra of a sample Manganese oxide nanoparticles. The optical absorption coefficient is measured for wavelengths ranging 200 to 600 nm. Furthermore, the manganese oxide samples' transparency could be detected at highe rwavelengths, then the absorption band boundaries are predicted to be roughly 391.71 nanometer. [Sagadevan, 2016].

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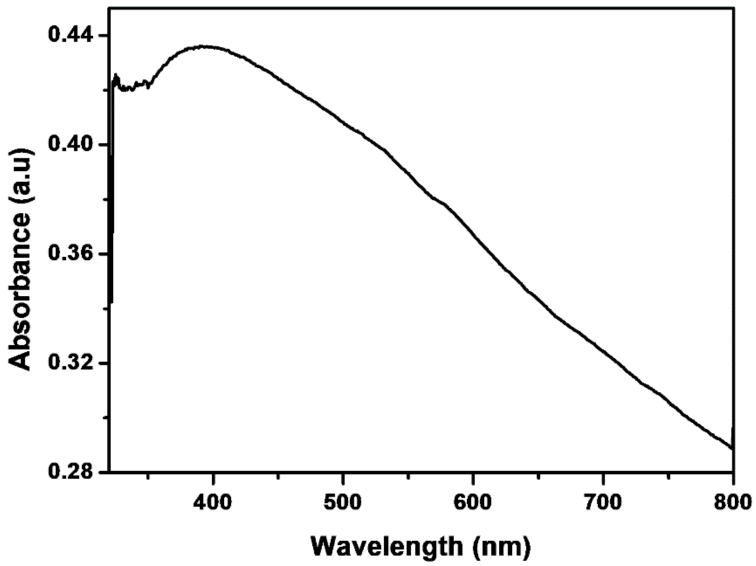
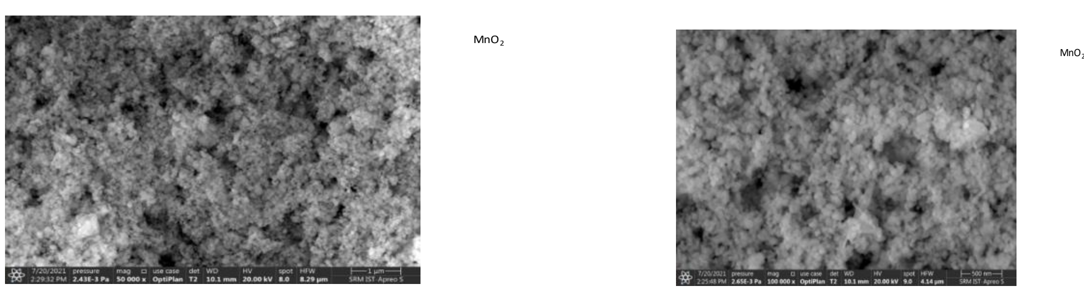


Fig.3.3 shows the UV-visible pattern of the annealed at 500 degree C for 3 hours manganese dioxide nanosheets. The moral arrangement of the results and survey of literature review and indicate the building of typical manganese dioxide nanosheet with planar construction and surface area is ultrahigh.. Liu,2017 and zhang 2017)

Morphological study

Using a High-Resolution Scanning Electron Microscope (HRSEM), the morphology, particle size, and crystallinity of MnO2 nanoparticles were studied (Fig. 3.4). MnO2 has agglomerated well-defined spherical particles as well as a nanosheet-like shape, as seen in Fig.3.3.



a) **Fig . 4-a&b -.HR-**SEM images of MnO2 (b)

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Elemental Analysis (EDX) of brown Manganese oxide

Furthermore, Elemental analyses of the prepared managaneseoxide (Mn2O)nanopowder were anlysed through dispersive X-ray spectrum (Fig. 3.5). It can also detect the presence of manganese and oxygen atoms in nanoparticles(Table 3.1)

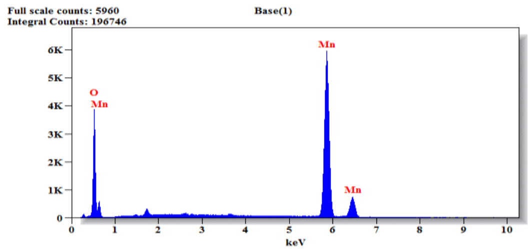

Fig. 3.5shows the Elemental composition of brown Manganese dioxide

Elemental present	Weight	Atom %	formation
O	15.38	38.42	O
Mn	84.62	61.58	Mn
Mn	Nil		nill
Total	100	100	

Table .3.11.Elemental analysis of precursor concentration using EDAX

CONCLUSION

The present study demonstrates the effect of the structural, morphological, and functional properties of Mn_2O nanostructures prepared by a simple chemical precipitation route. The XRD patterns indicates the particles exhibit a pure structure of cubic. Simple chemical method has been used to successfully prepare Mn2Onanoparticles, which are indexed as tetragonal Pyrolusit.The nanoparticles were estimated to be between 20 and 30 nm in size. The HRSEM microscopy study indicate theshape is spherical morphology with diameters ranging from 20 to 30 nm. Photocatalysis (e.g., CO2 reduction, CH3 CHO degradation, dye degradation, etc.) is one of the potential uses of the produced materials, as are dye sensitized, solar cells, lithium batteries, supercapacitor nanofluids with high thermal conductivity, heavy metal ion removal, and MRI.The UV exhibits the prepared manganese oxide were nanoparticles in the wavenumber ranges of 391.73cm-1. Such magnetic properties hint at several interestingprospects for future studies. This chemical route can be considered as an economical and facile approach toprepare Manganese oxide nanoparticle.

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