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ORIGINAL ARTICLE

Preparation Characterization and Comparative Study of Nano MnO_2 Using Various capping Agent

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ABSTRACT
MnO_2 nanoparticles were prepared size bellow 100 nm synthesized by hydrothermal technique by using the H_2SO_4 solution by adding $KMnO_4$ with the help of cyclohexane for surfactant reagent at temperature of 80° C. The surface morphology of the synthesized products was examined by scanning electron microscopy (SEM). The structural and compound identification of sample was carried out using X-ray diffraction is employed for characterization of the nanostructure. The results show that a MnO_2 nanoparticle with bellow 100 nm was synthesized by low temperature hydrothermal technique.
Key words: *Cyclohexane, X-ray diffraction, hydrothermal.*

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INTRODUCTION

The batteries are the important uses in our daily life. Inside of the batteries Li/Mno_2 then the MnO_2 is the very important of the batteries. They are widely used as catalysts, molecular, sieves and ion sieves and especially as electrode materials in batteries. $MnO_2$are most attractive materials because of its ion-exchange, molecular adsorption, magnetic properties, catalytic, and electrochemical properties. MnO_2 nanoparticles were several different structures, including α-, β-, γ-MnO_2. The properties of MnO_2 depend not only on the manganese oxidation state, but also on the structure type of MnO_2 nanoparticles.

There are large numbers of potential applications of MnO_2 metal nanoparticles such as in the field of electrode materials in different rechargeable batteries, biosensors, coatings, nanofibers, nanowires and also in specific biogenic and bioscience applications. Effect of organic solvents on nanoparticles of metals hydroxide or oxide formation during chemical precipitation was used for developing effect of nanodimensional materials. This is the important way for chemists to expand their activity into Nanoscience. The nanoMnO_2 particles haveexcellent adsorption material for treatment of several pollutants in water environment.

In this paper report a novel and simple approach to synthesized of MnO_2 three dimensional nano structures with diameters of below 100 nm by hydrothermal reaction at low temperature and requires no expensive raw materials and equipment's. And we also discussed the effect of capping agent in nano size. And find a suitable capping agent for preparing magnetic nano particle.

EXPERIMENTAL

MnO_2 can be obtained from reduction of potassium permanganate ($KMnO_4$) with sulfuric acid (H_2SO_4) during hydrothermal treatment. The chemical reaction between potassium permanganate and sulfuric acid can be formulated as:

$$MnO_4^- + 8H^+ + 5e \rightarrow Mn2^+ + 4H_2O \rightarrow 2\mathbf{MnO_2} + 8H^+$$

4gm $KMnO_4$ powder was dissolved into 2.5M of 200ml sulfuric acid aqueous solution while heating to 80° C for 1 hours along with stirring. The precipitates were produced and the solution color was changed during reaction, and the reaction course was monitored by the color change from purple to brown. The system was then naturally cooled to room temperature when the reaction finished. The obtained products were washed thoroughly with deionized water to remove possible remaining ions, and then

dried at 60° C for 50 hrs. Those named as sample 1 and sample 2 prepared by using PVP as capping agent and sample 3 prepared by using PEG as a capping agent.

RESULT AND DISCUSSION

The chemical composition of the as-synthesized and their crystal structure was analyzed by X-ray diffraction (XRD) with Cu Kα radiation. The morphologies of the samples obtained were observed using and scanning electron microscopy (SEM), are employed for characterization.

3.1. XRD

XRD is a non-destructive method. XRD is used to measure crystalline compounds and provides a quantitative and qualitative analysis of compounds that can't be measured by another method. XRD has been widely used for the determination of crystal structures and lattice constants of nano particles, and nanowires.

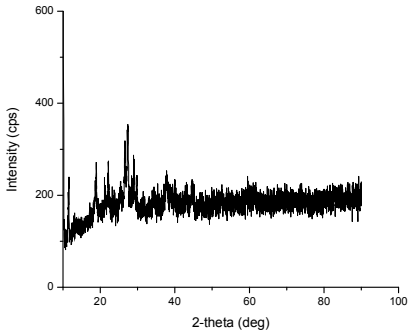

Fig 1-(a)

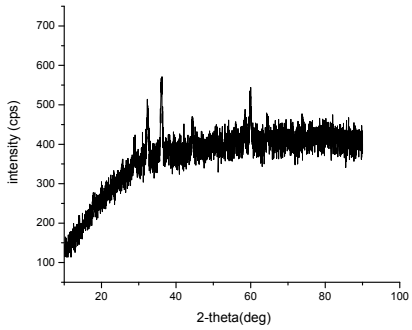

Fig 1-(b)

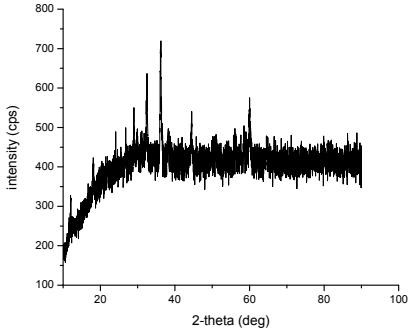

Fig 1-(c)

In here fig 1, 2, 3 are represent for sample 1, 2, 3. In sample one the decrease in size increases the energy so agglomeration occurs so particle crystal nature is reduced due to this there is no sharp peaks in the XRD data. And particle size is also more than 100nm. in sample 2 PVP used as capping agent it has excellent wetting property. Due to this it also fails to prevent the agglomeration. But it gives little stability to the magnetic nano particle so it forms sharp peaks in XRD. It shows particle are getting little shape and decrease in the agglomeration. In sample 3 PEG 6000 in this sample particle size is less than 100nm and crystal nature of the sample also increases. This shows PEG act as a good capping agent. The data's in XRD are well matched with JCPDS card no: 440141

3.2. SEM

SEM is one of the most widely used techniques used in characterization of nano particle. The resolution of the SEM is a few nanometers and the instruments can operate at magnifications from 10- to over 300,000. In here various nano ranges particle is observed for samples. Fig 2-(a) represent for the sample 1 it's prepared without surfactant it shows particles are formed in the range of 500 nm. Fig 2-(b) represent for sample 2 it's prepared using PVP as a surfactant it shows particles are present in the range of 100 to 150 nm. Fig 2-(c) represent for sample 3 its prepared using PEG-000 as a surfactant it shows particles are in the range of 30-70 nm.

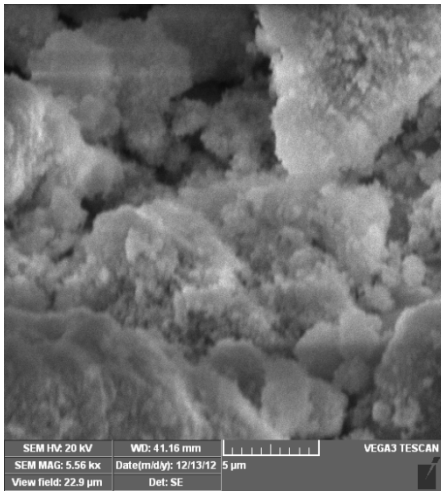

Fig-2 (a)

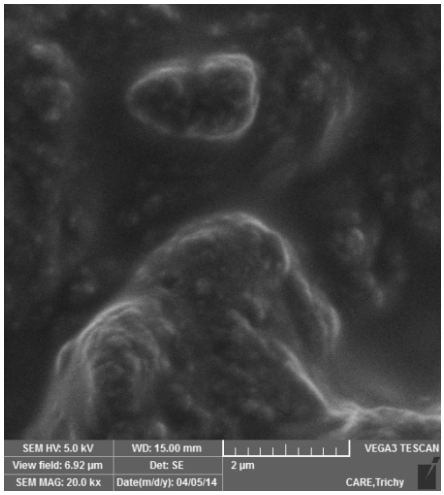

Fig-2 (b)

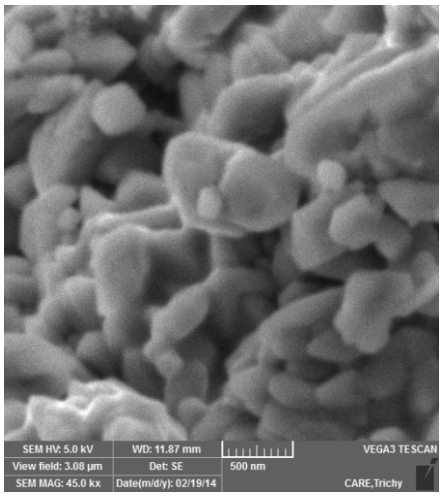

Fig-2 (c)

CONCLUSION

From the XRD report the sample 1 is mostly formed in amorphous form there is no clear peak in XRD indicate that and SEM images also confirmed that the sample formed in amorphous form the reason for this is the paramagnetic nature of MnO_2 magnetic materials have highly agglomerate nature because of its empty valance electron. Sample 2 shows three sharp peaks in XRD it shows the agglomeration reduces and sample shows some crystal nature. SEM images also show agglomeration reduce but it doesn't control agglomeration completely. In sample 2 we use PVP it hasa moisture absorbing nature due to this stability of nano particle is decreased. Sample 3 shows sample is formed in nano range and uniformed distributed. In sample 3 we use PEG as a surfactant it gives best report in nano particle preparation. And act as best capping agent for magnetic nano particle preparation.

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