ECO-FRIENDLY APPROACH FOR THE SYNTHESES OF CADMIUM OXIDE NANOPARTICLES

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ABSTRACT

In the present work, eco-friendly approach for the syntheses of cadmium oxide nanoparticles at low temperature has been prepared from the precursors by simple thermal decomposition route. The synthesized nanoparticles were characterized for their size and structure using X-Ray diffraction (XRD), high resolution transmission electron microscopy (HRTEM), selectedarea electron diffraction (SAED), and scanning electron microscopy (SEM) techniques.The diffraction peaks obtained from X-Ray diffraction of CdO nanoparticles revealed that it has a face-centered cubic structure with no impurities. HRTEM analysis confirmed the spherical particles with outer diameter of about 13 nm. SEM analysis shows the presence of prism shaped CdO nanoparticles with good separation

Key words: N*anoparticles, XRD, SEM, HRTEM&SAED*.

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1. INTRODUCTION

Studies on nanometer sized particles has created great excitement and expectation rapidly over the past decade. Metal oxide nanoparticles show interesting changes in their optical, magnetic, electrical, and catalytic properties accompanied by improved physical properties like mechanical hardness, thermal stability, or chemical passivity. Cadmium oxide (CdO) is a well known II– VI semiconductor with a direct band gap of 2.2 eV (520 nm) and has developed various applications such as its use in solar cells, transparent electrodes, photodiodes, and sensors. Recent day, several methods were attempted for the synthesize CdO nanostructures by different methods like Sol-Gel [1] hydrothermal method [2], reactive sputter [3] solvothermal methods [4], chemical co-precipitation method [5], vapor phase transport [6], thermal evaporation [7], and sonochemical method [8]. Among the large number of techniques employed for the synthesis of oxides, thermal treatment is found to be unique and highly versatile. It is an easy and fast process which yields high-purity, homogenous, crystalline oxides in a short time and with less energy. In this paper, we report a novel method of synthesis of cobalt oxide nanoparticles using the inorganic precursor $Cd(PhAc)_2(N_2H_4)_2$ and detailed structural characterization of these particles.

2. $Cd(PhAc)_2(N_2H_4)_2$: PRECURSOR FOR CdO NANOPARTICLES

2.1 Experimental

Preparation of$Cd(PhAc)_2(N_2H_4)_2$

Phenylacetic acid (0.9076 g, 0.006 mol) was added to 50 mL water containing 99 – 100 %, pure hydrazine hydrate (1.3 mL, 0.02 mol). The mixture was stirred well and heated over water bath to get clear solution. It was filtered and added slowly to an aqueous solution of the cadmium nitrate (1.028 g, 0.003 mol) with constant stirring.

The precursor was precipitated slowly on the addition of the ligand to the metal ion solution, which was kept for sometime and filtered, washed with distilled water, alcohol and ether and air dried.

Preparation of CdO nanoparticles by thermal decomposition method

The precursor thus prepared was taken in a clean silica crucible and heated gently at the starting and strongly when the decomposition started. The precursor was heated to red hot. As a result, the precursor was completely decomposed to the metal oxide.

2.2 Characterization of CdO nanoparticles

Phase analysis of CdO nanoparticles

Fig 1 shows the XRD pattern of as prepared CdO nanoparticles. The diffraction peaks of CdO nanoparticles reveal that it has a face-centered cubic structure [JCPDS No. 65-2908] and no diffraction peaks of the possible impurity phases such as CdO_2, $Cd(OH)_2$ and $CdCO_3$ are observed. The diffraction peaks at 2θ=33.04, 38.33, 55.33, 65.92, and 69.71° are associated with [111], [200], [220], [311], and [222] planes respectively, in the order of d-spacing values of 0.27, 0.23, 0.16, 0.14, and 0.13 nm. The estimated value of the lattice parameter is in close accordance with those reported. The prominent peaks have been utilized to estimate the grain size of sample with the help of Scherrer equation. The crystalline size of the powder is found to be 20.9 nm.

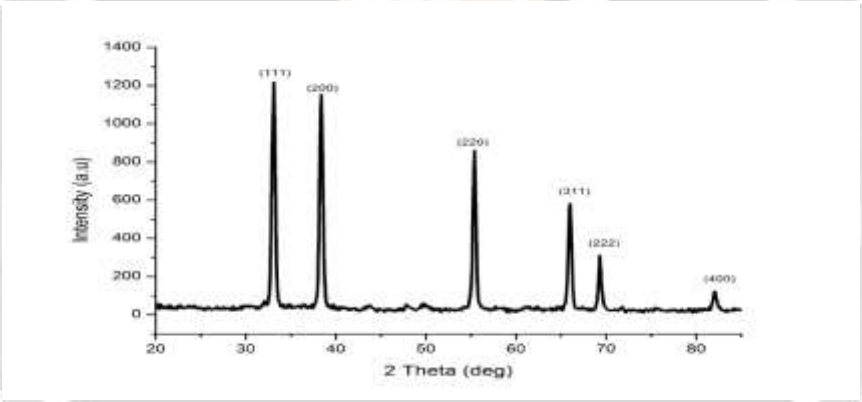

Fig 1 XRD pattern of CdO

Morphology analysis of CdO nanoparticles

Fig 2a and Fig 2b shows the presence of prism shaped CdO nanoparticles with good separation. The EDX spectrum (Fig 3) confirms the chemical composition of the nanoparticles, indicating the presence of cadmium and oxygen and no other impurities.

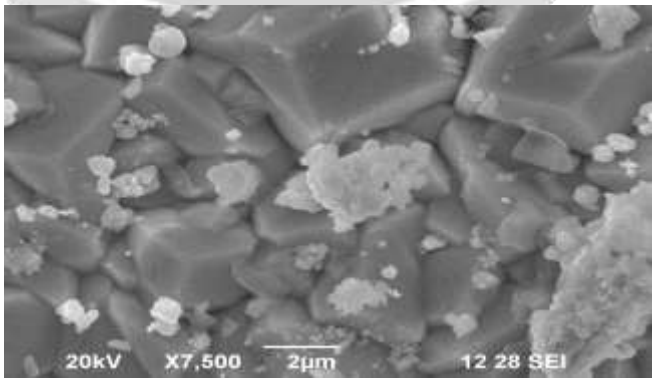

Fig 2(a) SEM image of CdO

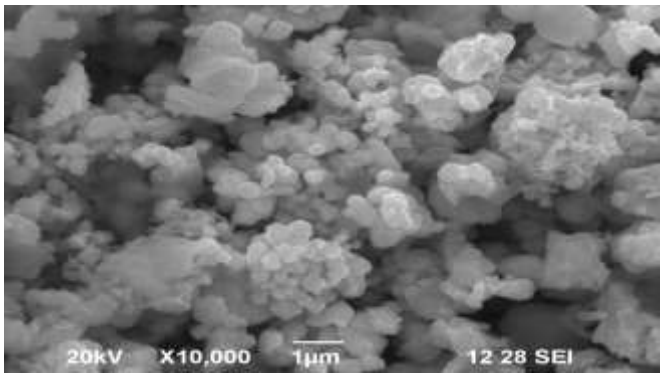

Fig 2(b) SEM image of CdO

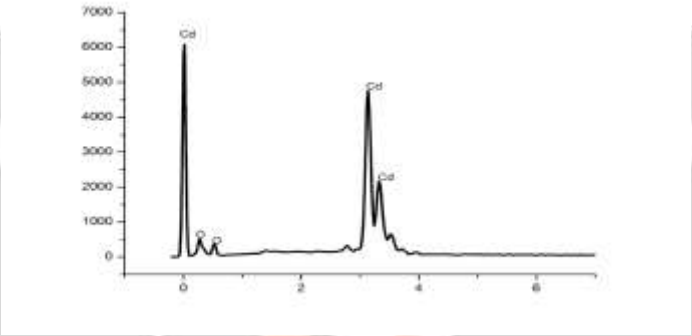

Fig 3 EDX ofCdO

Structural analysis CdO nanoparticles

As can be seen from Fig 4, the cadmium oxide powders derived from thermal treatment consist of nearly spherical particles with outer diameter of about 13 nm. It reveals the agglomeration of nanoparticles confirming theirnanocrystalline nature. The average grain size observed from the micrograph is in agreement with the calculation using Scherrer's equation. The corresponding selected area electron diffraction (SAED) pattern shown in Fig 5 consists of bright electron diffraction rings, proving the nanocrystalline nature ofcadmium oxide.

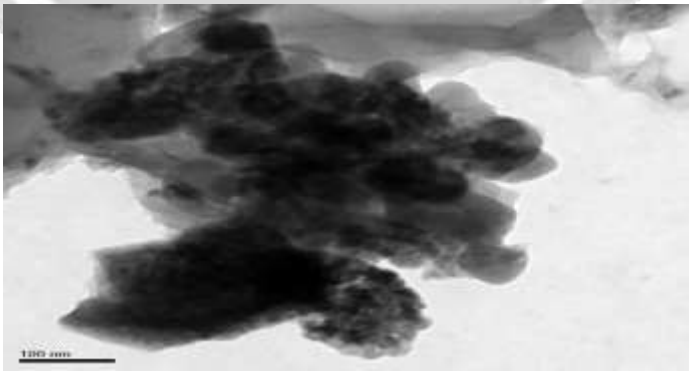

Fig 4 HRTEM image of CdO

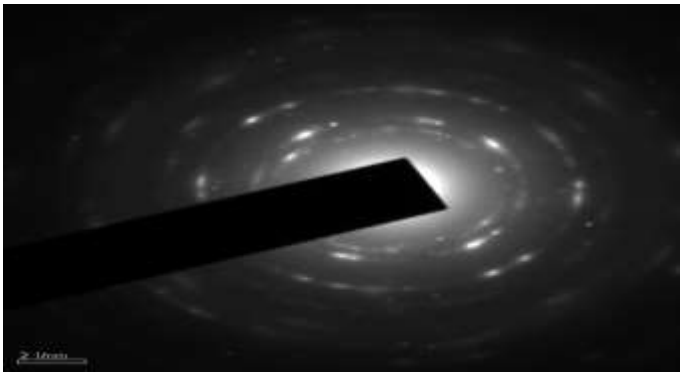

Fig 5 SAED pattern of CdO

3. CONCLUSION

In summary, cadmium oxide nanoparticles were synthesised from the precursor complex $Cd(Di\text{-}PhAc)_2(N_2H_4)_2$ via thermal decomposition. CdO nanoparticles reveal that it has a face-centered cubic structure, which is also confirmed by XRD studies. From the HRTEM observations, the cadmiun oxide nanoparticles are found to be of the average size of 13 nm which is consistent with the XRD result.

Thus, this novel route gives an efficient method of preparation of CdO nanoparticles.

4. REFERENCES

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