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Synthesis and Characterization of Corn Flack Type Nanostructures of Nickel Oxide by Chemical Bath Deposition Method

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ABSTRACT: In this work, reported the synthesis, structural and morphological properties of Nickel Oxide (NiO) thin films deposited on to glass substrates using chemical bath deposition method. For confirming structure & morphology of obtained NiO thin film, X-ray diffraction pattern and scanning electron microscopy analysis were studied. The obtained NiO has Corn Flacks type Structure.

Keywords: Nickel Oxide, Chemical Bath Deposition, Scanning Electron Microscope, Corn Flake Nanoparticle.

INTRODUCTION: The act of applying a thin layer to a surface is thin film deposition by any technique. The 'Thin' is a relative term, but most deposition technique control layer thickness within a few of nanometer. The chemical bath deposition uses a liquid precursor, usually a solution of organometallic powders dissolved in aqueous or an organic solvent. This is a relatively inexpensive, simple thin film process that produces Stoichiometrically accurate crystalline phase[1].

NiO has the NaCl Structure with octahedral Ni (II) and O_2 Sites. This structure is well known as the rock salt structure. Like many others binary metal oxides, NiO ratio deviates from 1:1. In nickel oxide this non stoichiometery is accompanied by a color change with the stoichiometrically correct. NiO being green and the non-stoichiometric NiO being black [2].

The NiO is used in many applications such in energy storage devices like Battery, Electrochemical capacitors [3-10]. It used in magnetic, dielectric application [11-12].It is also used in sensor applications [13].
There are many reports on shape, size of the synthesis of NiO nanoparticle [14-16].

MATERIALS AND METHODS: For synthesis of NiO film LR grade chemical were used. Nickel chloride, liquid Ammonia. Lime soda glass slide was used as substrate for film deposition. It was well cleaned by ultrasonic cleaner and distilled water. The 10 ml 2M $NiCl_2$ was taken in 25ml glass beaker and its pH was made 10. After that it is kept in water bath at 70 ^{O}C. After one hour there was formation of precipitation of very tiny particles of Nickel hydroxide complex which would be deposited on glass substrate. There was formation of film which was cleaned with distilled water to remove loose bounded particles on it. After that it was kept for drying at room temperature for 24 hrs. Film was annealed for 5 hrs for removing hydroxide and for recrystallization of material. The Structural identification of 5 hrs annealed (300 degree Celsius) NiO film was studied using X-ray diffraction pattern. The XRD spectrum was recorded with reguka-D/MAX 2500 x-ray diffractometer operating X ray tube voltage 20-80 kV, with auto divergent slit and scanning speed of 5 deg-min.

RESULTS AND DISCUSSION: The x-ray diffraction (XRD) pattern of NiO film prepared by a simple CBD method. The most intense reflection plane was (200) plane; characteristics of spinel phase. The other lower intense reflection peaks (111), (220), (311) were also seen in the diffraction pattern. All the peaks were well- indexed to (JCPDS card no. 73-1523) supporting the formation of single spinel phase of NiO as there were no other peaks either from impurity or from other phases of Nickel oxide[17]. Noise in the spectra is due low crystalline nature. The two-dimensional surface morphology of NiO film was confirmed from digital photo-images recorded by SEM images. It was seen from figure 2(a) that, many corn flake like structures were amalgamated. In addition to regular structure islands were detected. With increase in magnifications figure 2(b), it was noticed that these island

were made up of several small crystallites of corn flake like dimensions and were well-connected to base morphology. There large Air-void free which can be applicable for gas sensor, electrochemical supercapacitor, catalytic activity. The individual crystallite exhibited size 200-300nm.

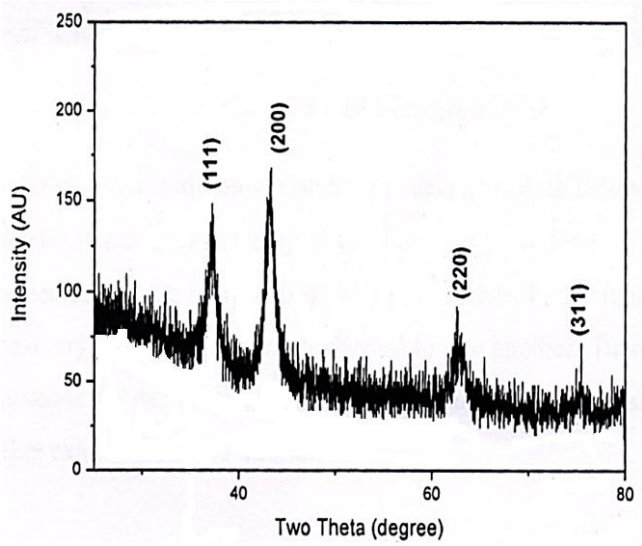

Figure 1:X-ray Difraction pattern.

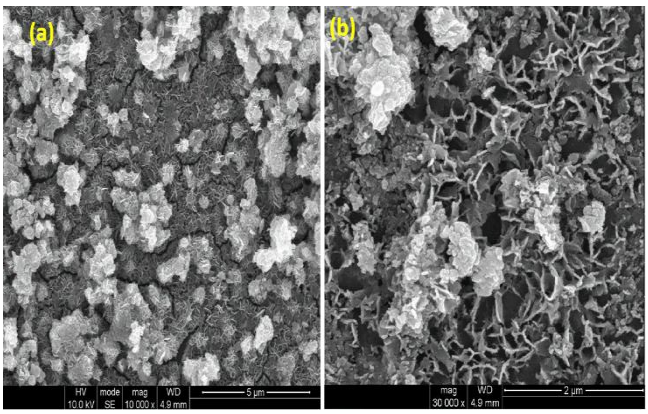

Figure 2: SEM images (a) low magnification (b) High Magnification.

CONCLUSION: The NiO thin film are prepared on to glass substrates using chemical bath deposition method. The structural, Morphological analysis of NiO Film was studied by X-ray diffraction pattern and scanning electron microscopy. The two dimensional surface morphology of nickel oxide confirms the NiO having large voids and surface area. The individual crystallite exhibited 200-300 nm size and 20-30 nm thickness.

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