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Indium Oxide as a material for biological applications; structural properties and biocompatibility

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ABSTRACT: In_2O_3 Nnao particles produced by chemical method in order to further its use in biological applications. Aqueous solution contains Indium chloride and NH_3 and heated for 40 minutes as deposition time. Aqueous solution temperature for synthesis was about 70ºC temperature and kept at 2.5 pH. Indium Oxide Nano particles achieved from evaporated aqueous solution in special oven at 250ºC temperature. X-ray diffraction (XRD), Scanning electron microscopy (SEM), Atomic Force microscopy (AFM) proved the production of Indium Oxide Nano particles. Nano particles have semi amorphous structures, round shapes and smooth roughness.

Keywords: Indium Oxide; chemical bath deposition; structural properties; XRD; SEM; AFM

INTRODUCTION

Indium components are not known to have any metabolic role in any organism. In a similar way to aluminum salts, indium (III) ions can be toxic to the kidney when given by injection, but oral indium compounds do not have the chronic toxicity of salts of heavy metals, probably due to poor absorption in basic conditions. Radioactive indium (in very small amounts on a chemical basis) is used in nuclear medicine tests, as a radiotracer to follow the movement of labeled proteins and white blood cells in the body. In_2O_3 is an n-type semiconductor with a wide band gap (3.5-3.7 eV) that shows the unusual combination of good optical transparency in the visible region and high electrical conductivity. Indium oxide (In_2O_3) has been investigated extensively for its semiconducting properties. Indium oxide thin films show unique shape and size dependent properties. In_2O_3 thin films have been formed by number of different deposition techniques which include PLD (Chen *et al.,* 2008), direct current (DC) magnetron sputtering (Curreli *et al.,* 2008), spray pyrolysis (Huang *et al.,* 2001), sol-gel (Ruda *et al.,* 2006), thermal evaporation [6] and electron beam evaporation (Wagner and Ellis, 1964). The aim of this work is to produce In_2O_3 Nano particles and investigated about their Nano structure and crystalline properties by XRD, SEM and AFM analysis.

EXPERIMENTAL DETAILS

Indium Oxide Nano particles were formed in many successively deposition steps that always were performed in renewed chemical bath (CBD) prepared from Indium chloride, NH_3 and distilled water. The deposition bath was continuously stirred, heated for about 40 minutes. Deposition parameters were [Indium chloride] = 3×10^{-3}M; [NH_3] = 3×10^{-1} M; pH = 2.5. During the deposition the bath temperature was 70°C. After 40 minutes deposition time, aqueous solution transferred to special oven and evaporated at 250°C for about one hour.

Crystal and phase structure of the deposited Indium oxide Nano particles were identified using an X-Ray X, pert MPD diffractometer (CuK_α radiation, λ=0.15406nm) with step size of 0.03 and count time of 1s per steps. Nano structures were investigated by SEM(S-3400, Hitachi, Japan). Surface physical morphology were obtained by means of AFM (Dual Scope ^{TM}DS, 95-200/50).

RESULTS AND DISCUSSION

Figure 1 shows the X-ray diffraction pattern of Indium Oxide Nano particles, produce at 40minutes chemical deposition time, by CBD method. The resultant product displayed the characteristic XRD peak corresponding to semi amorphous nature of our layer. Noisy XRD pattern relates to glass plate that we put Nano particles in to it for X-ray analysis.

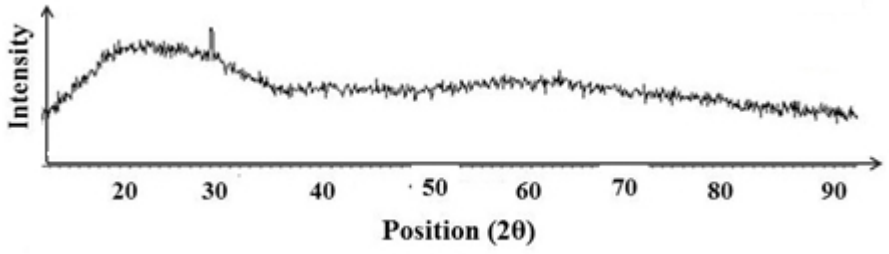

Fig. 1. XRD pattern of Indium Oxide Nanoparticles deposited by CBD method.

Figure 2 shows the SEM image of produced Indium Oxide Nano particles in this work. As it can be seen, round Nano particles grown in mesoporous structures.

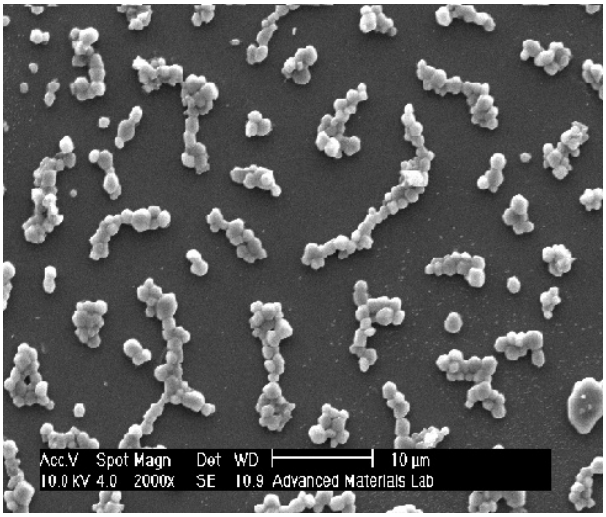

Fig. 2. The SEM image of Indium Oxide Nanoparticles deposited by CBD method.

Figure 3 shows the AFM image of produced Indium Oxide Nano particles in this work. As it can be seen, Nano particles grown in separated sharp peaks by smooth roughness like saw tooth possessing.

CONCLUSIONS

In_2O_3 Nnao particles produced by chemical method in order to further its use in biological applications. Aqueous solution contains Indium chloride and NH_3 and heated for 40minutes as deposition time. Aqueous solution temperature for synthesis was about 70ºC temperature and kept at 2.5 pH.

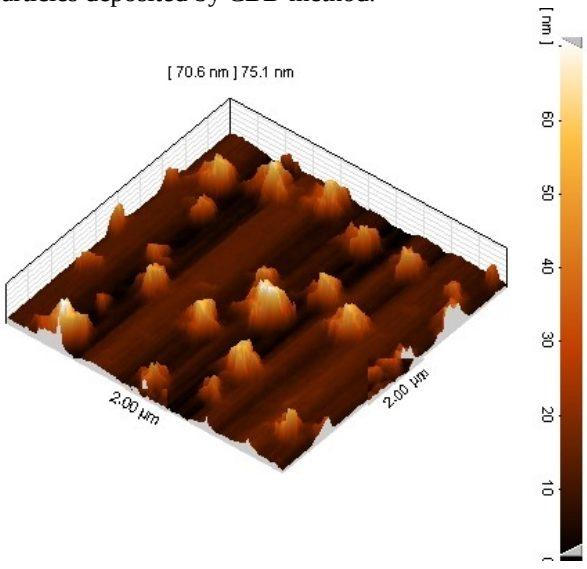

Fig. 3. The AFM image of Indium Oxide Nano particles deposited at 40 minutes, by CBD method.

Indium Oxide Nano particles achieved from evaporated aqueous solution in special oven at 250ºC temperature. X-ray diffraction (XRD), Scanning electron microscopy (SEM), Atomic Force microscopy (AFM) proved the production of Indium Oxide Nano particles. Nano particles have semi amorphous structures. In agreement with XRD results, in morphology of Nano particles canonical grains are clearly shown. From SEM result fractal structures grown that looks like ferns and broccoli (and its stalks) and bon like structures. Indium Oxide Nanoparticles do not have the chronic toxicity of salts of heavy metals. This can be useful to biological applications.

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