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Effect of Beta Irradiation Time on Structural Characteristics of Copper Oxide Using Laser Ablation

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ABSTRACT

Cu_2O andCuOcollodial NPs were synthesized by pulsed laser ablation of Cu target in double distilled water(DDW) at room temperature. High purity Cu target (purity of 99.99%) was fixed at bottom of open a plastic cellcontaining of 2.5 ml DDW. The primary particle size calculated by Sherrerformula is about 50 nm. The spherical nanoparticles morphologies were carried out by atomicforce microscope (AFM)analysis, exhibits spherical with average size distribution found to be 60 nm.

Keywords:-Copper , Irradiation , Beta RAY , Structural .

1.INTRODUCTION

Copper oxides are semiconductors that have been studied for several reasons such as the natural abundance of starting material copper (Cu); the easiness of production by Cu oxidation; their non-toxic nature and the reasonably good electrical and optical properties by Cu_2O [1]. Copper forms two well-known oxides: tenorite (CuO) and cuprite (Cu_2O).Copper oxide thin films have potential applications in areas such as photovoltaics and electronic device fabrication [2, 3, 4]. Copper oxide has two major types, cuprous oxide (Cu_2O) and cupric oxide (CuO). Cuprous oxide (Cu_2O) belongs to the space group Pn_3m, and its unit cell has two copper and four oxygen ions. These are arranged with oxygen atoms in a cubic lattice structure surrounded tetrahedrally by copper ions [5]. Cupric oxide (CuO) has a monoclinic crystal structure in which each Cu has four oxygen neighbours [6]. These two close copper oxides show distinct XRD spectra. They have good electrical and optical properties. The band gap energy for the semiconductors is typically in the range 1.21-2.1eV for CuO [7, 8] and 2.1-2.6eV in Cu_2O [7]. And there are Several methods such as: thermal oxidation [9]; electrodeposition [10]; chemical conversion [11]; chemical brightening [12]; spraying [13]; chemical vapor deposition [14]; plasma evaporation [15]; reactive sputtering [16]; and molecular beam epitaxy [17] have been used to prepare copper oxide thin films. In most of these studies, a mixture of phases of Cu, CuO and Cu_2O is generally obtained and this is one of the nagging problems for non-utilizing Cu_2O as a semiconductor. Pure Cu_2O films can be obtainedby oxidation of copper layers within a range of temperatures followed by annealing for a small period of time. And Both oxides are semiconductors, Cu_2O having a direct bandgap of about 2.1 eV and therefore strongly absorbing at wavelengths below 600 nm, with a reddish appearance. CuO, with Eg=1.3 [19], is absorbing throughout the visible spectrum.

2.EXPERIMENTIAL WORK

Q-switched Nd/YAG laser system type HUAFEIproviding pulses of 1064 nm and 532 nm(frequencydoubled) wavelength with maximum energy per pulse of1000 mJ, pulse width of 10 ns, repetition rate of 10 Hz andeffective beam diameter of 5 mm, was used for laserablation. The laser is applied with a lens with 110 mm focal length. Cu_2Ocollodial NPs were synthesized by pulsed laser ablation of
High purity Cu target was fixed at bottom of open a plastic cell containing of 2.5 ml DDW atroom temperature. Ablation is carried out with laseroperating at 1.064 nm wavelengths and (80 laser pulses).

3.RESULT AND DISCUSSION

To clarify the crystalline structure, an XRD pattern of theas-prepared Cu_2O andCuOcolloidal NPs (Figure 1) after beta irradiation. Thediffraction peaks at around 30 and38.9^{o}are assigned to(110) and (200). No diffraction peaks due tometallic Cu or oxides werediscerned. The diffraction peaks in the XRD patternbroadened due to the particles in the sample are too small.The primary particle size calculated by Sherrer formula isabout 50 nm.

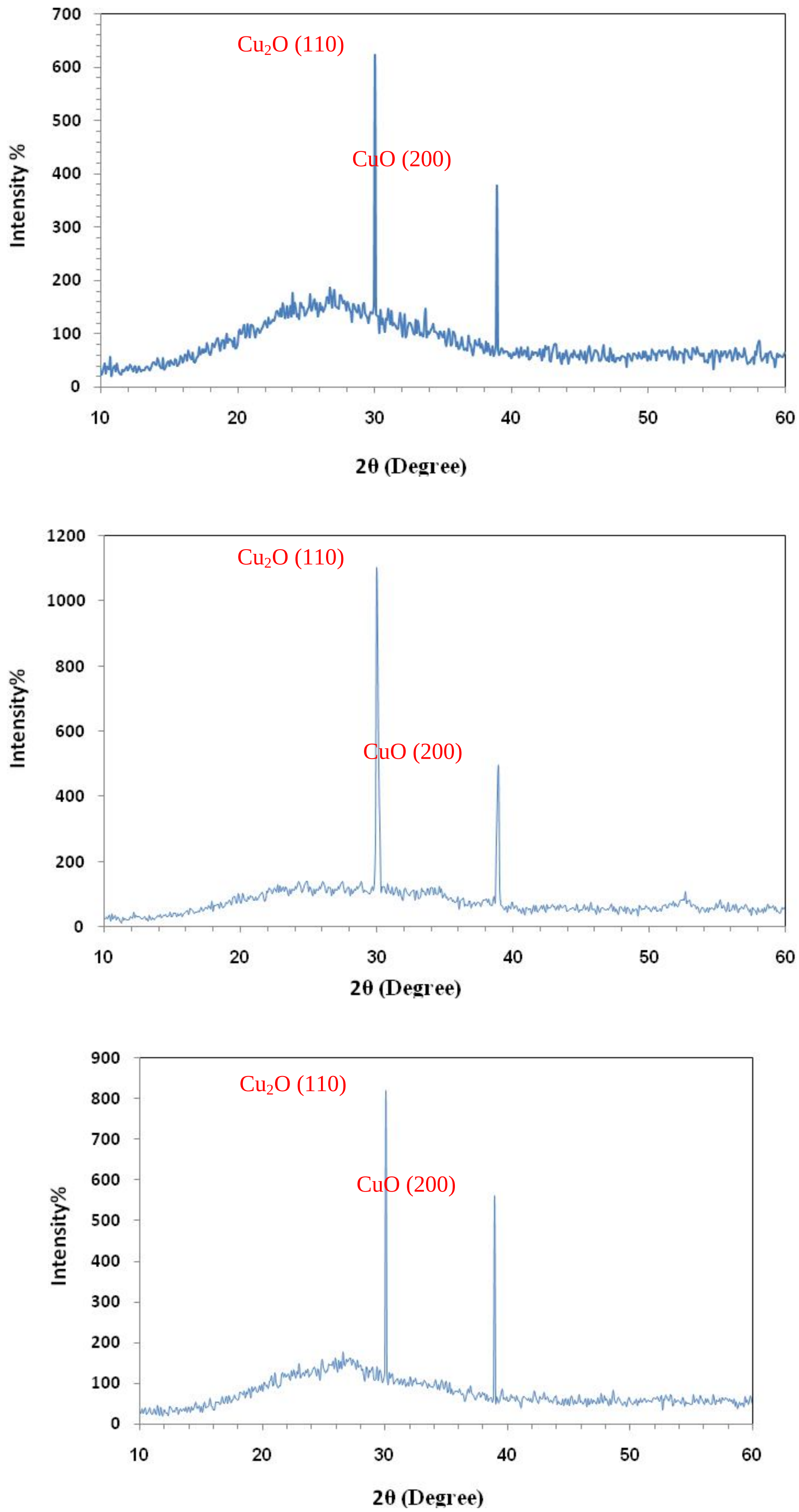
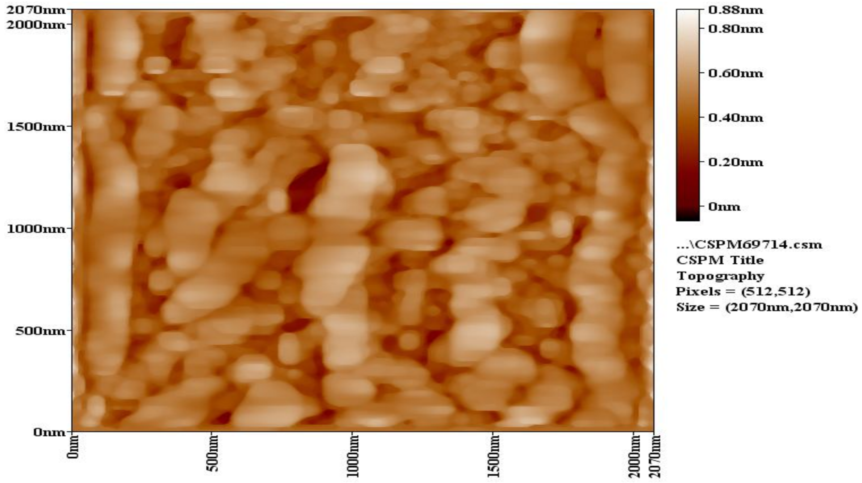
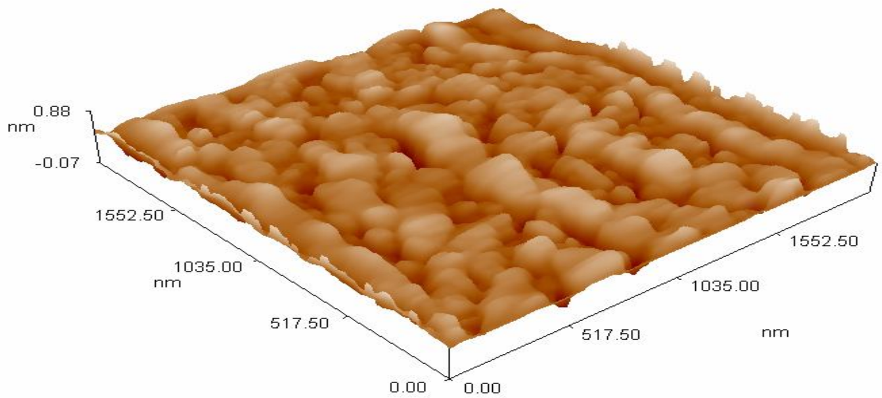
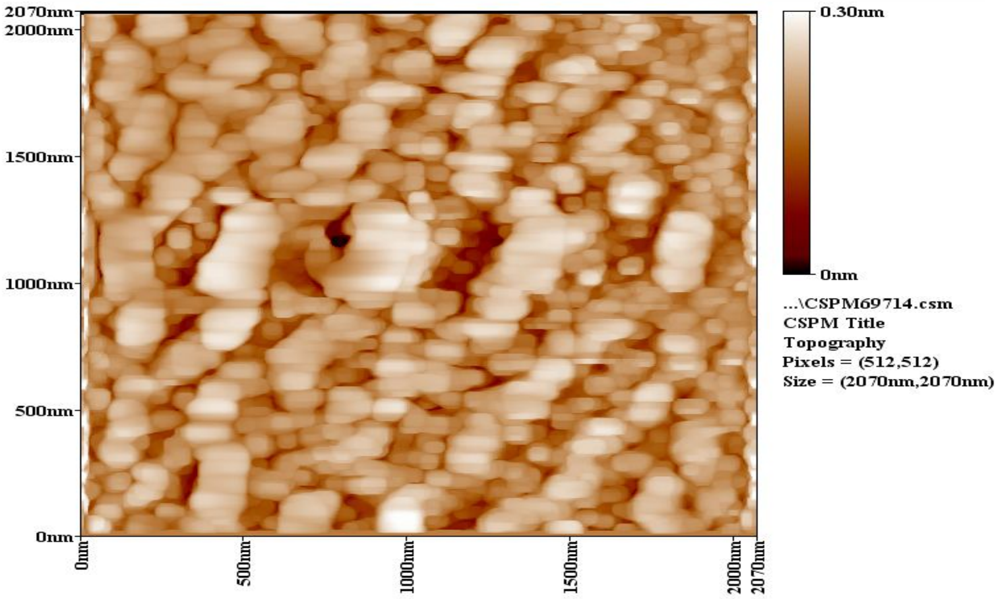


Figure 1. (a, b, c): XRD parten of CuOcolliodal NPs supentionpreperd by drop drying on quartz substrate using laser ablation unde water.

The surfacemorphology of CuO colloidal nanoparticles after different beta irradiation time asobserved from the AFM micrographs proves that the grainsare uniformly distributed for 2D and 3D views withindividual grains extending upwards as shown in figure (2)(a) (b) and (c). The surface of the CuO colloidalnanoparticles were characterized using AFM micrographs.It shows a change in roughness of the oxide surface withcalcined temperature. It is known that the increase insurface roughness may cause deterioration of the electricaland optical properties.







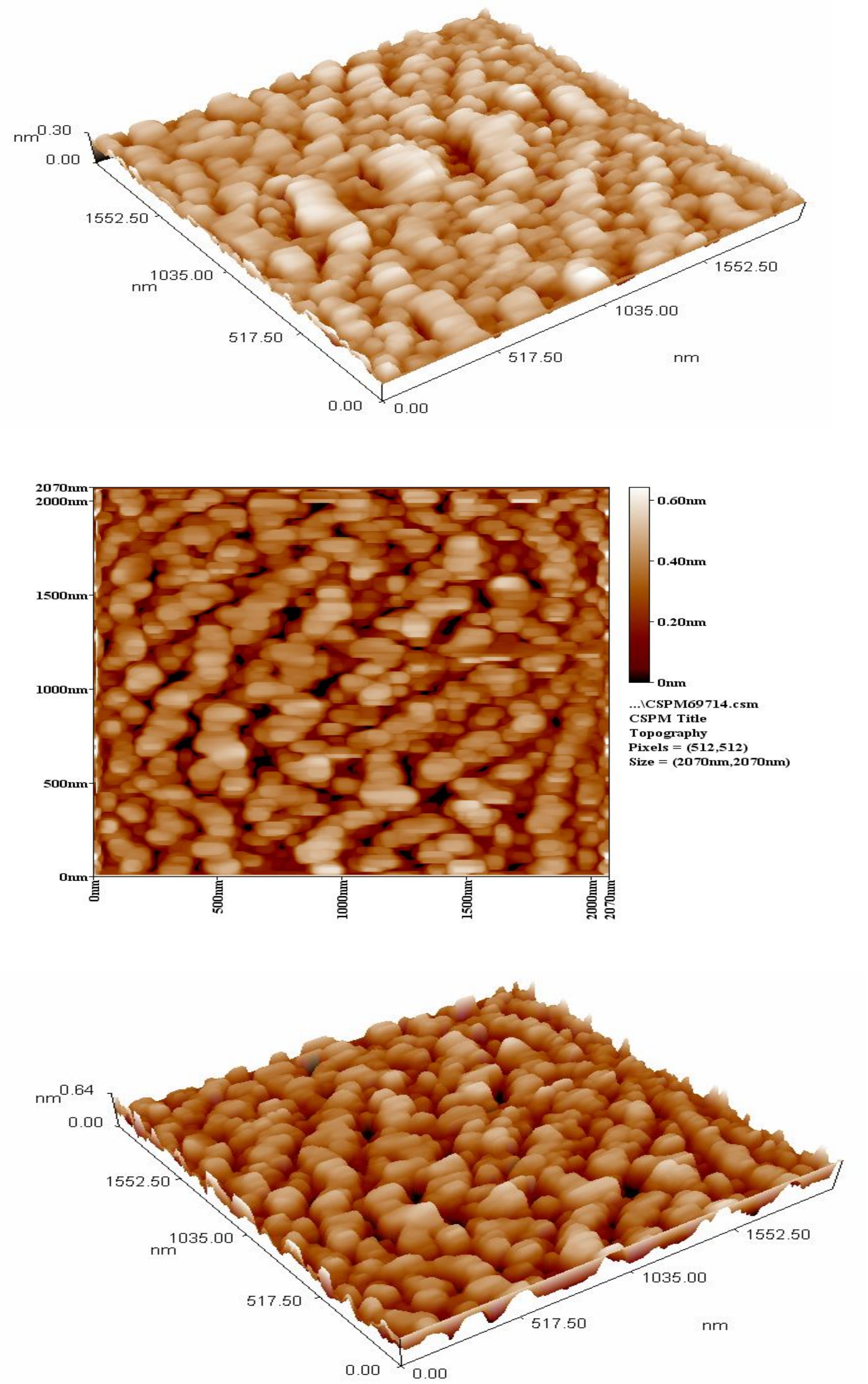


Figure 2. (a, b, c): AFM image of $Cu_2O$and CuOcolliodal NPs supentionpreperd by drop drying on quartz substrate using laser ablation unde water.

4.CONCLUSION

Cu_2O andCuOcollodial NPs were synthesized by pulsed laser ablation of Cu target in double distilled water(DDW) at room temperature. High purity Cu target (purity of 99.99%) was fixed at bottom of open a plastic cellcontaining of 2.5 ml DDW. Several small brightspherical shaped ***$Cu_2O$and CuOcolliodalNPs*** are moreclosely anchored throughout the film surface and the AFMresults show uniform distributed of the Nanoparticles onthe substrate. The primary particle size calculated bySherrer formula is about 50 nm. The averge grain sizefound to be about 60 nm while the roughness average valueabout (0.89 and 6.77) nm, the difference in particle sizeand surface roughness related to the the uniform growthand distrubution of ***$Cu_2O$and CuOcolliodal NPs*** on substratesurface at higher tempreture.

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