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Comparison of the nanostructure obtained by annealing on conductive metals copper and aluminum at same temperature and same annealing time

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Abstract - Detailed structural and optical characterizations confirmed that the as-grown nanostructures were highly crystalline, possessed a wurtzite hexagonal phase, had grown along the c-axis direction and exhibited excellent optical properties. Moreover, the fabricated FETs show a high conductivity ON/OFF ratio of about~10^2 with ultraviolet (UV) light and hence provide an effective way to use these devices in nanoscale UV detectors and optoelectronic switches. Morphology and microstructure of the nanowires was studied as a function of temperature and annealing time using scanning electron microscopy and E-DAX- techniques .

The structure and morphology of thin aluminium-oxide and copper oxide films grown by the dry, thermal oxidation of a bare Al and Cu substrate in the temperature range of 773 K were studied using Xray photo electron spectroscopy and high resolution electron microscopy. The microstructure and phase constituents of these metals were studied by metallography , FESEM and EDX Techniques.

In this paper, we investigate the oxidation behaviour of copper and aluminium at temperatures 500° C for 4 hours and its mechanism. The oxides formed after oxidation at low temperatures have different crystal structures . The presence of such an oxidation layer slows down the oxidation rate constants by an order of magnitude. This study demonstrates the oxidation of copper at low temperature and aluminium at high temperature are controlled by the grain boundary diffusion. Increasing the crystal size in the surface oxide reduces the oxidation rate significantly

***Key Words*: Nano Structures, FESEM and EDX Technique**

1.INTRODUCTION

A nanostructure is a structure of intermediate size between microscopic and molecular structures. Nano structural detail is microstructure at nanoscale. A method is provided for improving metallic nanostructure stability.

The metallic nanostructures are annealed in an atmosphere oxygen. The annealing temperature is less than the melting temperature the metal material in bulk form. In response to the annealing, stabilized metallic nanostructures are formed. If the stabilized metallic nanostructures are exposed to an ambient air environment the stabilized metallic nanostructure maintain the first diameter.

Strong materials are a classical goal for materials research and development. Today there is focus on nanostructured metals since they are found to have a very high strength as well as other excellent mechanical properties . Nanostructured metals can be processed by a number of different techniques and can be found by different techniques

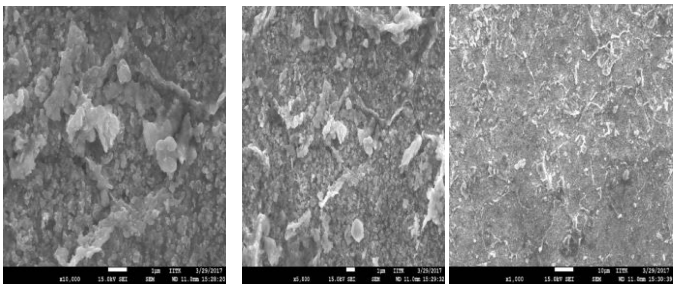
1.1 Sample preparation

Copper and aluminium samples were prepared in the size of(9X9X1mm^3) and (10X10X2mm^3) respectively by the use of hacksaw cutter and filler blade. After preparing samples of require size copper sheet and aluminium sheet was first cleaned in dilute nitric acid to remove the native oxide layer and adsorbed impurities. The foil was then thoroughly rinsed with distilled water followed by filter paper for soaking liquid. Thermal oxidation of Cu and Al sheet were carried out in a resistively heated furnace at same temperature 500° C and times under flowing oxygen atmosphere. In all the experiments, the rate of heating of copper and aluminium sheet was maintained at 2^0 C/sec and after oxidation, samples were quenched by removing from furnace. An atmospheric air flow rate was maintained during the complete cycle of heating, oxidation and quenching of the samples. Surface morphology of the samples was studied using a field emission scanning electron microscope (FESEM). FESEM micrographs of CuO and Al_2O_3 nanowires prepared by annealing copper strips for 4 h and 15 minutes under atmospheric air at 500° C. Length and diameter of CuO and Al_2O_3 structures were measured from SEM images. Chemical composition of the structures was confirmed by recording Energy dispersive X-ray analysis (EDX) spectrum.

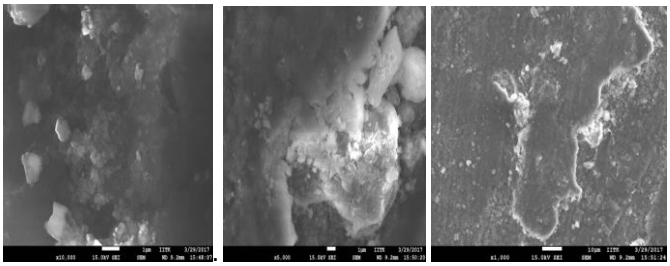
RESULT

The result is divided into two parts
1. Fesem microstructure
2. EDX image

1.Fesem microstructure



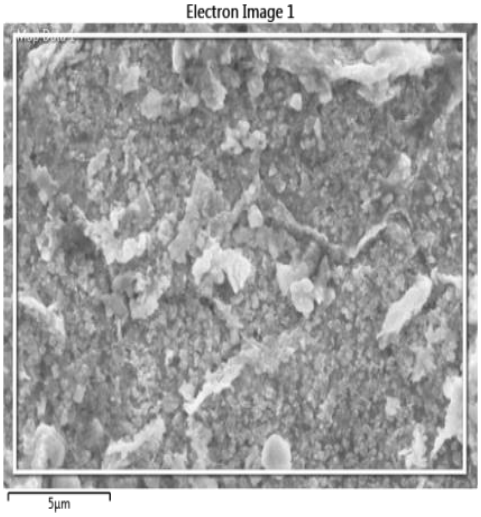
1. Fesem microstructure of received copper at 500° C at 20,000 X
2. Fesem microstructure of received copper at 500° C at 10,000 X
3. Fesem microstructure of received copper at 500° C at 1,000 X

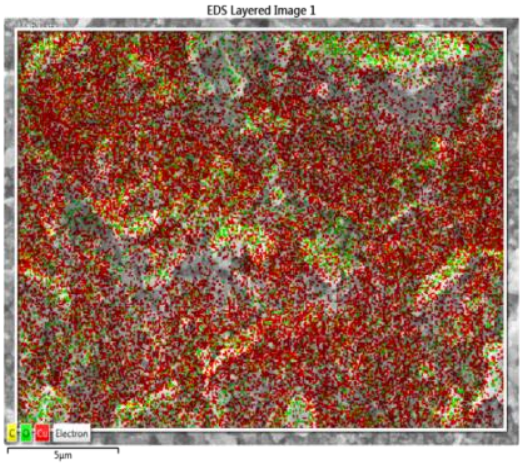


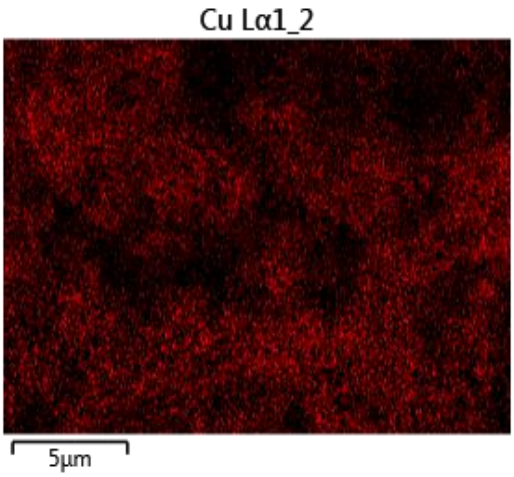
1. Fesem microstructure of received aluminum at 500° C at 20,000 X
2. Fesem microstructure of received aluminum at 500° C at 10,000 X
3. Fesem microstructure of received aluminum at 500° C at 1,000 X

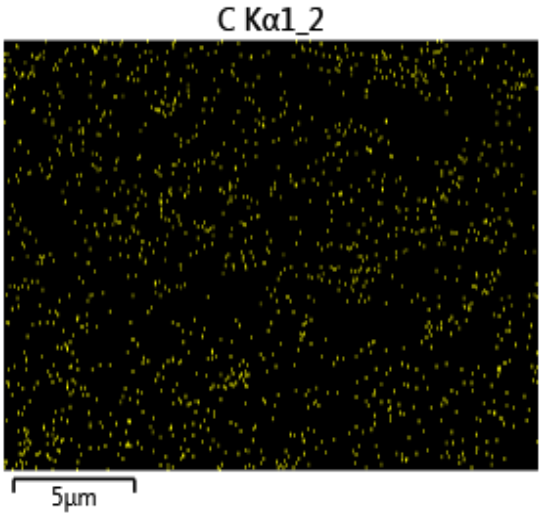
2.EDX images

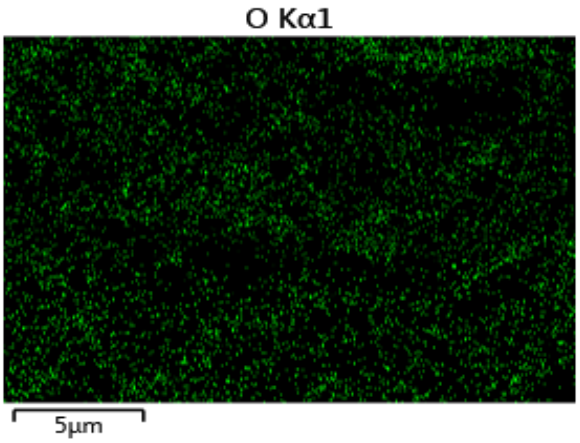
a.Copper at 500⁰ C for 4 hours

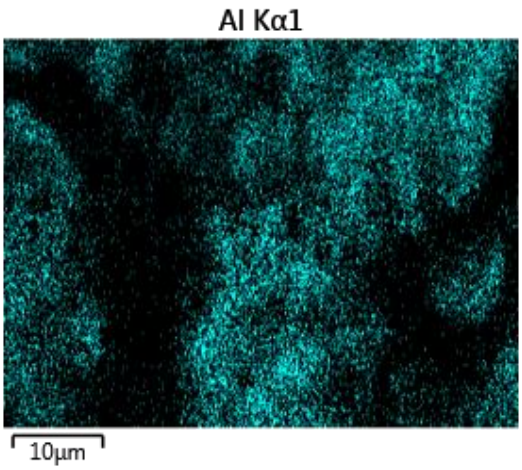


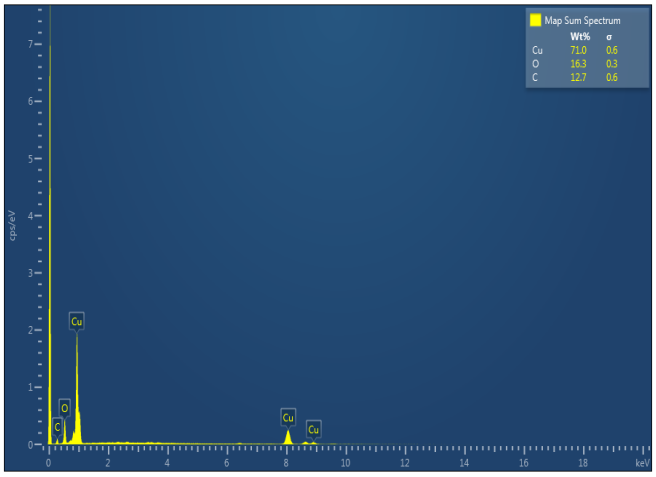


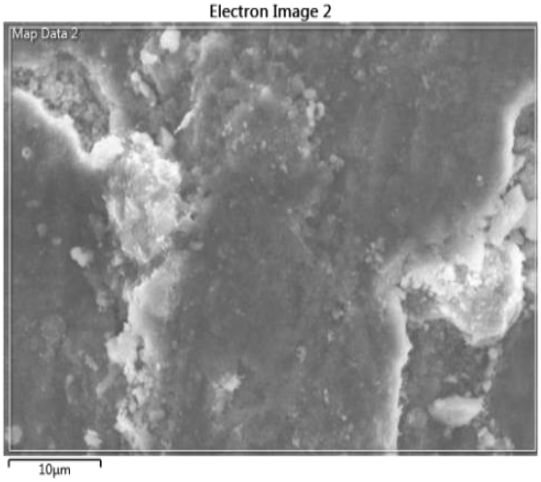




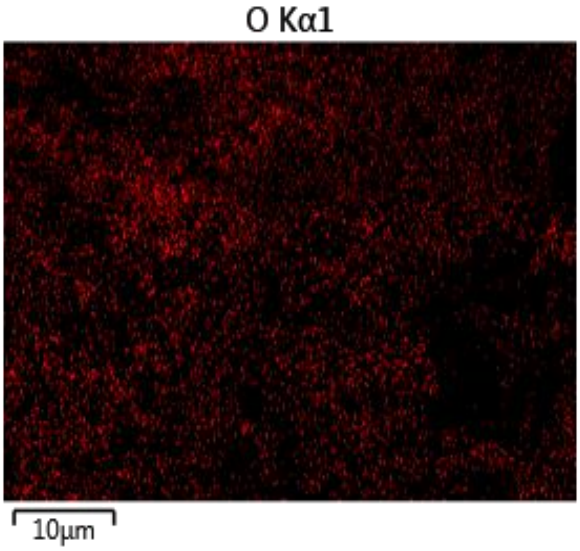




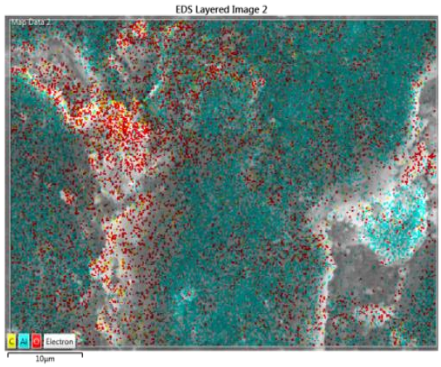


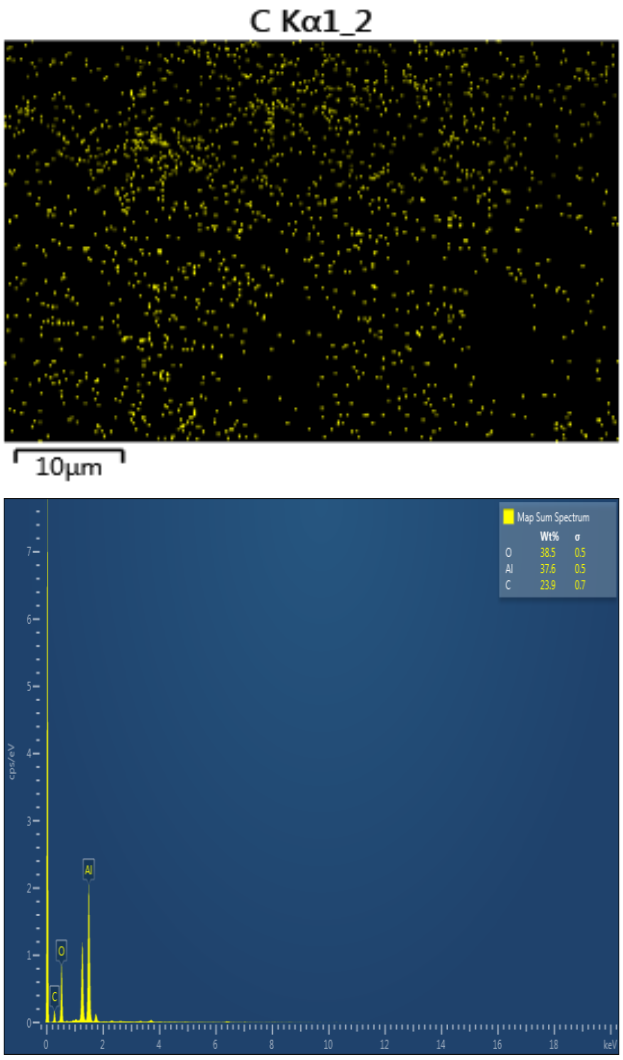


The abscissa of the EDX spectrum indicates the ionization energy and ordinate indicates the counts. Higher the counts of a particular element, higher will be its presence at that point or area of interest. This graph represents the composition of constituents of copper, oxygen and carbon. It is based on the atomic weight of contestants. After annealing at 500 C of copper for 4hours, copper forms cupric oxide with oxygen and some other particle find out at the surface of the copper. Hence EDX shows that copper is not pure. There is some amount of oxygen and carbon also present in metal and copper oxides form.



b.Aluminum at 500⁰ C for 4 hours





The abscissa of the EDX spectrum indicates the ionization energy and ordinate indicates the counts. Higher the counts of a particular element, higher will be its presence at that point or area of interest. This graph represents the composition of constituents of aluminium, oxygen and carbon. It is based on the atomic weight of contestants. After annealing at 500 C of aluminium for 4hours, aluminium forms oxides of aluminium with oxygen and some other particle find out at the surface of the aluminium. Hence EDX shows that aluminium is not pure. There is some amount of oxygen and carbon also present in metal and aluminium oxides form.

3. CONCLUSIONS

Different types of Nano structures are generated at copper and aluminium. Nano structures of Copper are more uniform to aluminium. Nanowires cannot be generated at higher temperature 500^0C on Aluminium because aluminium is melted at more than this temperature when we heat it for 4 hours. Nanowires cannot be generated at cryogenic temperatures which is lower than the melting point of copper.

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