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Study Some Structural and Optical Properties of Copper Nano Film

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ABSTRACT

Copper films have been widely used as electrodes and interconnection wires in integrated electronic circuits and other application. In this research has been deposition films of copper in the system of evaporation assisted laser Nedmyum - Yak pulse with a wavelength (nm 1064) and energy (400 mJ) and enabled quality factor is the rate of frequency (3Hz) and long pulse 10 nanoseconds, and by (50 p) pulse deposition of nano-membranes of high purity copper from the substrate of the glass in the temperatures reached ((100,200, 300 C °) in a vacuum (10-3 m bar) and then make a heat treatment at temperatures (300 C °) films . Some structural ,optical and electrical properties has been inspected films prepared. The results showed that the structures(XRD , AFM, Optical microscopy) of thins is strongly dependent on the temperature of the substrate. Also results of the optic transmission reach more than 90%,electrical resistivity decreased with increased temperature of substrate . Making these films suitable for many conductive electrode diverse applications.

Key Word:- nano film, transmittance, annealing, XRD.

1.INTRODUCTION

Nd: YAG laser is an inexpensive, efficient, highly reproducible thin-film growth technique that has been widely adopted in many industrial applications, including semiconductor chip fabrication. Although extremely diverse thin-film materials have been successfully fabricated by sputtering processes, the most straightforward application of sputtering is metal film deposition by using a metal target under high vacuum conditions[1]. Copper may be the most widely studied metal films, and they have been extensively used as interconnection wires in semiconductor chips[2].
However, it can be quite difficult to produce high-quality films of Cu, because the metal atoms (and metal clusters) in the chamber and on the film surface are highly vulnerable to oxidation by the presence of residual oxygen in the chamber [3]. Se. Lee et al,[4] study sputtering technique for Cu thin film was epitaxially grown on an Al2O3 (sapphire) (0001) substrate, and had high crystalline orientation along the (111) direction. M Fenn et al [5]study electrical resistivity and temperature coefficient of resistivity (TCR) of Cu and Nb thin films have been measured over a range of layer thicknesses between 5.6 nm and 1106 nm. E. Schmiedla et al. [6] study resistivity of ultra-thin metal films is much higher than theoretically predicted by the scattering hypothesis. The effect is discussed with respect to the variation of film thickness for copper films deposited under ultra-high vacuum conditions on glass substrates. The interpretation on the basis of a statistical model leads to reasonable results even when the variation of temperature is included into consideration. Additional information is obtained from photoelectric and field effect measurements. V. Timoshevskii et al. [7] find that atomic-scale surface roughness dramatically affects the electrical conductivity of thin films. Atomic clusters, 1–3 atoms high, deposited on the flat Cu001˙ surface of an 11 monolayer thick film lead to a 30−40% reduction of its conductance. This is attributed to the destruction of isotropic Fermi surface sheets. The goals of this paper is to fabrication copper nano powder by evaporation technique , and study some of their properties.

2.EXPERIMENTAL WORK

Preparation of substrates:
The substrates that used is laboratory glass sheet slides with diminutions of in standard dimension as (3x2x0.2) cm and purity (99.99%) .And clean by alcohol 99% with ultrasonic waves produced by Cerry PUL 125 device for 15 minutes in order to remove the impurities and residuals from their surfaces and distilled water ,then dying in air. Using thermal acuum evaporation system type EDWARDS with Mo- boat , Figure 1, deposition rate was 2 nm/sec at (10-2 m bar) .The distance from the substrate to evaporation source about (3 cm) with powder (400 mJ) at different temperature(100,200,300 T C°) .
Nd: YAG laser (**1.064 μm**) Second Harmonic Generation (SHG) was used for the deposition of Cu on different substrates temperature. Power density (0.8- 1.8) J/cm2,pulse width: 10ns,repetition frequency: (6) Hz ,cooling method: inner circulation water cooling .Annealing process was done in vacuum furnace type (IVOCLAR type Programat X1,Germany) Inspection: In order to study the structural properties, the nature and the crystal growth of the deposited films at different depositing conditions, X-ray diffraction measurements have been done by using Philips PW 1050 X-ray diffractometer of 1.54 Å from Cu-kα. In order to observe the surface topography of deposited thin films, Atomic