INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: **Linear and Non-linear Optical Properties, Surface Plasmon Resonance and Surface Scaling Behaviour of Nanostructured Cu Thin Films Fabricated via PLD Technique**

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Thesis Submitted to the Department/ Center : Physics

Date of completion of Thesis Viva-Voce Exam : 17-Dec-2019

Key words for description of Thesis Work : Thin Film, Pulsed Laser Deposition, Surface Plasmon Resonance Atomic Force Microscopy, Spectroscopic Ellipsometer, Z-Scan

SHORT ABSTRACT

The present thesis is aimed towards the fabrication and characterization of semitransparent nanostructured copper thin films deposited on the glass substrate via pulsed laser deposition technique. The linear as well as nonlinear optical properties and surface plasmon resonance characteristics of Cu thin films have been studied. These properties were correlated with the size and shape of the nanoparticles, surface morphology, growth dynamics and stoichiometry of the film.

The two sets of nanostructured Cu thin films were fabricated via pulsed laser deposition. The first set is deposited at room temperature as a function of deposition duration (4, 6 and 8 minutes) followed by gradual annealing up to 400°C. The second set of the films deposited directly at the substrate temperature of 400°C for the duration of 6 to 45 minutes.

The particle size distribution, surface characteristic parameters, surface scaling behaviour, power spectral density function, activation energy etc. of these films were estimated using atomic force microscopy images. The fractal nature of the as-deposited room temperature Cu film was marginal and extreme fractal but the post annealed films to a final temperature of 400ºC, the fractal nature changed to Brownian fractal irrespective of deposition time which signifies self-affine nature of the film surface. The plasmonic features of the films were observed by recording the absorption spectra via UV-visible spectrometer. The SPR peaks of Cu films exhibited both longitudinal and transverse mode where the peak energies were found to be dependent on size, shape and aspect ratio of the Cu nanoparticles. The Bruggeman effective medium approximation theory was applied to determine the film composition whereas the formation of the interfacial layer and plasmonic behaviour of these copper thin films as a function of deposition time were investigated from spectroscopic ellipsometry spectra. The third order nonlinear optical properties of Cu films were carried out by using modified Z-scan technique under cw He-Ne laser at 632.8 nm wavelength. The NLO coefficients/nature were observed to be dependent on the deposition temperature and the size of the nanoparticles. Finally, the viability of nanostructured Cu thin film as surface enhanced Raman scattering substrate for metallic single wall carbon nanotube was also achieved.