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Title:Oxidation kinetics of nanoscale copper films studied by terahertz transmission spectroscopy Authors:Ramanandan, Gopika K. P. (1); Ramakrishnan, Gopakumar (1); Planken, Paul C. M. (1) Author affiliation:(1) Faculty of Applied Physics, Delft University of Technology, Lorentzweg 1, 2628 CJ Delft, Netherlands

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Abstract:Terahertz (THz) transmission spectroscopy is used to measure the oxidation kinetics of copper thin films evaporated on silicon substrates. The transmission of broadband THz pulses from 1 to 7 THz through the copper film is measured while it gets oxidized at an elevated temperature in ambient air. The change in the transmitted THz electric field is correlated with the growth of the cuprous oxide layer and the decrease in thickness of the copper layer. Oxidation curves were obtained for heating temperatures of 120-150 C and were found to follow a parabolic rate law. Using the Arrhenius equation, we calculate an activation energy for diffusion of 0.55 eV. By measuring the THz transmission through unoxidized copper layers of several thicknesses, we also measured the optical properties of thin copper films around the percolation threshold thickness of 7 nm. Around the percolation transition, the optical properties of freshly deposited copper thin films are very different from that of copper layers of the same thickness remaining after partial oxidation of thick copper films. © 2012 American Institute of Physics. Number of references:31

Main heading: Terahertz spectroscopy

Controlled terms:Activation energy - Copper - Electric fields - Metallic films - Optical properties - Oxidation - Percolation (fluids) - Percolation (solid state) - Thin films

Uncontrolled terms:Ambient air - Arrhenius equation - Copper films - Copper layer - Copper thin film - Cuprous oxide layer - Elevated temperature - Heating temperatures - Nano scale - Oxidation kinetics - Parabolic rate law - Partial oxidations - Percolation thresholds - Percolation transition -Silicon substrates - Terahertz - Terahertz transmission - Thin copper films - THz pulse -Transmission spectroscopy

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