

Spectroscopic Ellipsometry Study of Spark Plasma Sintered Nano Silver

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Spark Plasma Sintered (SPS) silver layers were studied by Spectroscopic Ellipsometry (SE) using an M-2000V spectroscopic ellipsometer from J. A. Woollam Co., Inc. which operate in rotating compensator mode [1][2]. Silver sample was prepared from nano particles on copper substrates under a pressure of 33 MPa [1], [2]. Ellipsometric studies were performed in the UV-Visible range as a function of the temperature between -30°C and 250°C. Dielectric constants were determined from an analysis of experimental data. The structural model consists of a copper (Cu) substrate coated with a layer of silver without roughness. Two types of optical models were chosen for the analysis of the sintered silver layers: the Drude model (Ag-Gen-Osc function) and an effective medium coupled layer (« EMA-coupled ») with a Lorentz function added (Ag-Lorentz) to the Drude dielectric function. In the framework of the Drude model, the electrons are delocalized or free and the parameters to be adjusted are the resistivity (ρ : Ωcm) and the time constant relaxation (τ : fs). With the Lorentz function which models the localized or bound electrons, the parameters are the amplitude of an oscillator (the intensity of the line i : A_i (eV)), the broadening coefficient (the linewidth i : B_i (eV)) and the frequency of the oscillation (the center line i : E_i (eV)). Two oscillators were used for the analysis in the spectral range from 370 nm to 1000 nm for the following temperatures: [-30, 0, 25, 30, 60, 62, 72, 82, 92, 113, 134, 150, 178, 206, 250] °C. The resistivity and the relaxation time constant as a function of the temperature was thus determined as well as the skin depth as a function of the wavelength for a given temperature. The latter is given in figure 1 on a log-log scale. A linear fit is achieved.

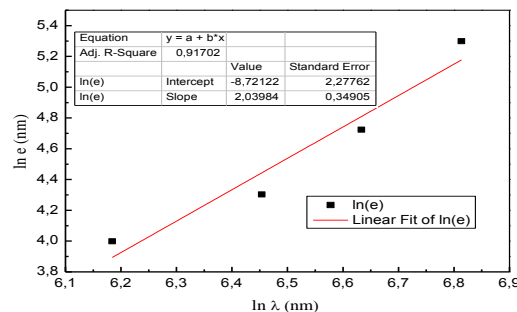


Fig. 1 Linear plot of the skin depth as a function of the wavelength.

Transport properties of samples prepared under different conditions are also studied as a function of two sintering pressures (3 MPa and 33 MPa). Electrical conductivity compares well with those determined by a direct four point probe electrical measurement method.

References

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