Temperature coefficient of resistance and thermal expansion coefficient of 10-nm thick gold films

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TEMPERATURE COEFFICIENT OF RESISTANCE AND THERMAL EXPANSION COEFFICIENT OF 10-nm THICK GOLD FILMS

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Abstract

A methodology to simultaneously estimate the temperature coefficient of resistance (α_R) and the thermal expansion coefficient (α_T) of metallic films with thickness in the nanometric range in a film/substrate system is discussed. An analytical model which takes into account the thermo-resistivity and the piezo-resistivity effects to estimate α_R and α_T of metallic films from experimental data obtained at room conditions is proposed. The methodology is first validated by using 100-nm thick Au films which yields values close to the bulk, providing confidence on the reported values. The proposed methodology was used to obtain α_R and α_T of 10-nm thick Au films deposited by thermal evaporation with three deposition rates onto two substrates. The results show that for 10-nm thick Au films α_R presents similar values than previous reports, meanwhile α_T is between 5 to 6 times higher than the corresponding bulk value; the arrangement of the atoms during the films deposition yields only minor variation in such a thermal parameter.

Keywords: thermal expansion coefficient, temperature coefficient of resistance, Au films, nano-thickness.

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