The determination of size and shape of supported particles is an unavoidable step in the understanding of the chemical or physical properties appearing at the nanoscale. For metals, plasmonics offers a powerful and flexible tool to characterize at a glance the average morphology in situ during growth. Its outcomes compare favorably with Grazing Incidence Small Angle X-ray Scattering [1,2]. The strength and sensitivity of the optical approach will be illustrated through the Surface Differential Reflectivity Spectroscopy (SDRS) study of the vapor deposition of silver on Al₂O₃(0001) at various temperatures (190-675K). Changes in size, shape and density were derived from the UV-visible optical response modeled in the framework of Bedeaux-Vlieger surface susceptibilities by assuming that supported clusters were in the form of truncated spheres. The pivotal importance of temperature dependence of the dielectric constant and of plasmon absorption broadening in the data modeling [3] was demonstrated. The optical approach was validated through a critical comparison with the physics of crystalline growth from nucleation to coalescence [4]. By decreasing drastically the acquisition time, the optical measurement was also applied to the real time analysis of sputtering deposition showing the role of coalescence hindrance with fast deposition rate. Finally, the surface susceptibilities were extracted directly by means of an algorithm based on Kramers-Kronig analysis, from the simultaneous measurements of the two polarization states [6]. By disentangling the substrate contribution, the inversion of reflectivity measurement allowed revealing and following all the multipolar absorption modes through oscillator peak fits (Figure). Some perspectives regarding similar simulations in the case of core-shell particles and adsorption will also be given.

Keywords: Plasmon, Growth, Differential Reflectivity Spectroscopy, Interface susceptibilities

References