

PhD Thesis offer – 3 years

Laboratory: Laboratoire Mixte CNRS/Saint-Gobain, Surface du Verre et Interfaces (<http://svi.cnrs.fr/spip/?lang=en>) et Institut des NanoSciences de Paris, « Oxydes en Basses Dimensions » (<http://www.insp.jussieu.fr/-Oxydes-en-basses-dimensions-.html?lang=en>) Université Pierre et Marie Curie, CNRS et Saint-Gobain Recherche

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Nanoplasmonics of supported particles

Nanoplasmonics, *i.e.* the study of optical properties of nanometric-sized metallic objects is a rich and vivid scientific field owing to potential applications (color filters, light trapping in photovoltaics, molecule detection...). Its richness lies in the extreme sensitivity of localized surface plasmon to the morphology of objects. It can therefore be used to probe particles well beyond the diffraction limit in a non-destructive way in any transparent medium with an extreme sensitivity to size, shape and environment. The SVI/INSP groups have developed over the past years an original approach to probe *in situ* and in real time the growth of particles or the reverse process of dewetting using UV-visible spectroscopy [1,2,3]. Combined with suitable dielectric modelling [4], fine details of physics of growth processes as well as of light-induced polarization could be revealed (Fig. 1) [1,2,3]. The simulation relies on the concept of interfacial susceptibilities applied to geometries of truncated sphere or spheroids in the quasi-static approximation [1,4].

In close connection to experiments performed in both teams, the aim of the first part of the proposed PhD is to expand the capabilities of the existing simulation tool [1], towards:

- size/shape distributed particles to account better for experimental data;
- more complex or irregular shapes, such as core-shell particles to describe gas adsorption or particles supported/embedded on/in a thin continuous film.

In second part, and within the framework of the reduced Rayleigh equation [5], the influence of retardation effects, of particle faceting/shape, of disorder and of coupling between diffraction and scattering for objects grown on patterned surfaces (Fig. 2) will be explored.

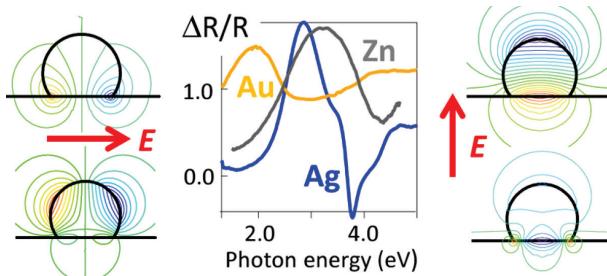


Figure 1: Differential reflectivity spectra for various metals on alumina and simulated absorption modes

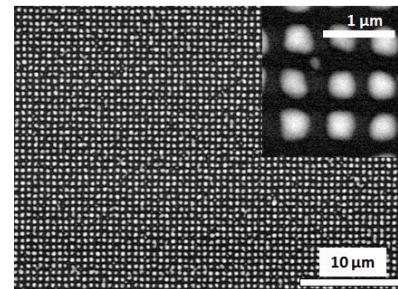


Figure 2: Array of Ag nanoparticles obtained by solid-state dewetting on a silica surface patterned by nano-imprint.

The PhD thesis is a part of the industrial chair of I. Simonsen between ANR and Saint-Gobain Recherche. The project aims at understanding and simulating the optical properties of complex systems relevant to the glass industry. A good background in physics and optics is required as well as a genuine interest for numerical simulations and dialog with experimentalists. Moreover, communication skills in English are required.

Funding (3years): ANR contract

References

- [1] <http://web.phys.ntnu.no/~ingves/Software/GranFilm/Current/>
- [2] R. Lazzari and J. Jupille, 23 (2012) 135707 and 22 (2011) 445703
- [3] R. Lazzari, I. Simonsen et al., J. Phys. Chem. C, 118 (2014) 732
- [4] D. Bedeaux and I. Vlieger, Optical Properties of Surfaces, Imperial College Press
- [5] I. Simonsen, Eur. Phys. J. Special Topics, 181 (2010) 1