# Effect of film thickness on the optical behavior of silver nanoparticles/polymer nanocomposite films*

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Dispersion and chemical stability of nano-objects in a dielectric matrix remains a challenge in nanocomposite films preparation. For noble metal nanoparticles (NPs) (Ag, Au ...), *in situ* synthesis methods exist : the chemical reduction of a noble metal salt is achieved either by thermal annealing or by photoreduction and the polymer matrix acts as a reducing agent. These *"one-pot synthesis"* protocols are usually simpler than *ex situ* synthesis methods but their mechanism is today not fully understood although being the subject of an increasing number of publications. Since the pioneering work of Oates and coworkers [1], the optical properties of silver NPs/polymer films can be efficiently probed by spectroscopic ellipsometry (SE). They are characterized by the presence of an strong absorption peak due to the surface plasmon-polariton resonance (SPPR) phenomenon [2]. In recent articles [3,4], we studied, using AFM analysis and SE, that the effect of the annealing time on the onset of the plasmon resonance in thick films (d > 500 nm). In this paper, we considered the optical behavior of thin (20nm) and thick (300nm) Ag-doped polymer films at high silver content. The topography of the films was studied by atomic force microscopy and the roughness parameters of the thin films were found to be larger than those of the thicker ones. The parameters of the surface plasmon-polariton resonance are also thickness-dependent (Fig. 1).

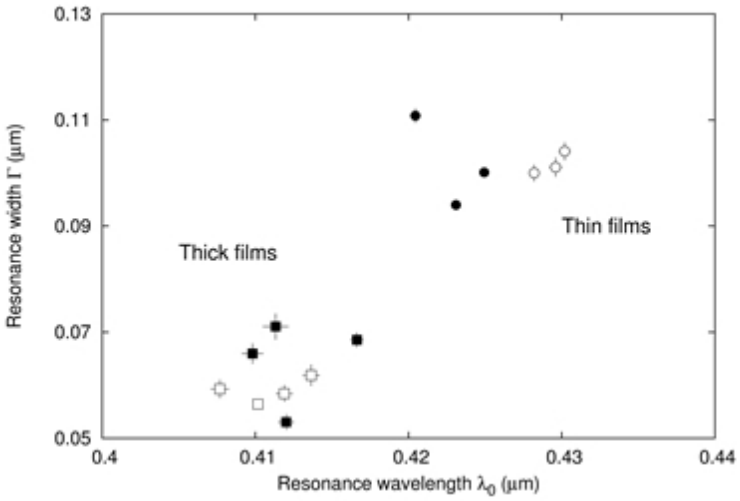


Figure 1: Resonance width ($\Gamma$) versus resonance wavelength ($\lambda_0$) for Ag-PVA films (open symbols : 12 % Ag ; plain symbols : 2.5 % Ag)

## References

[1] T. Oates, E. Christalle, *J. Phys. Chem. C* **111** (2007) 182.

[2] A. Heilmann, *Polymer films with embedded metal nanoparticles*, Spinger, 2003.

[3] N. Dahmouchène, M. Voué, J. De Coninck, *phys. stat. sol. (c)* **5** (2008) 1210

[4] M. Voué, N. Dahmouchène, J. De Coninck, *Thin Solid Films* **519** (2011) 2963.

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