

Optical behavior of poly-(vinyl)alcohol films embedding silver nanoparticles : a statistical analysis of the film thickness effect

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Poly-(vinyl) alcohol (PVA) films embedding silver nanoparticles (NPs) are interesting model systems to investigate the plasmon resonance of noble metals from a bottom-up point of view [1]. Indeed, using a one-pot synthesis scheme [2], NPs are directly grown in the film by reducing the Ag⁺ ions to Ag⁰, the energy required by the reaction being provided by heating the film at moderate temperatures (90°C to 160°C).

In this contribution, we used spectroscopic ellipsometry to study the optical properties of the nanocomposite films and to determine their thickness [3,4]. We compared the behavior of thick ($d > 100$ nm) and thin films at high and low silver (AgNO₃/PVA < 6% w:w) contents over more than 100 samples.

We have shown that, beyond its role of stabilizing the NPs and preventing them from aggregation, the polymer matrix and in particular its thickness helps in controlling the optical parameters of the plasmon resonance: at the same silver content, thin and thick films have slightly but significantly different optical behaviors.

[1] A. Heilmann - Polymer films with embedded metal nanoparticles – Springer, 2003.

[2] S. Porel, N. Venkatram, D. Narayana Rao and T. P. Radhakrishnan - In situ synthesis of metal nanoparticles in polymer matrix and optical limiting application – J. Nanosci. Nanotechnol. **7**, 1, 2007.

[3] N. Dahmouchène, M. Voué and J. De Coninck - Silver nanoparticles embedded in polymer matrices - a FTIR-SE study – phys. stat. sol. (c) **5**, 1210, 2008.

[4] M. Voué, N. Dahmouchène and J. De Coninck - Annealing of polymer films with embedded silver nanoparticles: Effect on optical properties – Thin Solid Films **519**, 2963, 2011.

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