Ligand-free synthesis of gold nanoparticles incorporated within oriented cylindrical block copolymer films

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ABSTRACT

Mixing gold nanoparticles with nanostructured block copolymer films is a self-assembled way of building potential optical metamaterials. We report here the inclusion of gold nanoparticles (AuNPs) without pre-functionalization step in oriented films of block copolymer poly(styrene)-b-poly(vinylpyridine) (PS-b-PVP) on a substrate. After deposition with an appropriate solvent, PS-b-P4VP and PS-b-P2VP are cast as films presenting either perpendicular and parallel cylinders. By including gold salt in these solutions and operating subsequent sonication, AuNPs (with a diameter of 2 nm) are synthetized and found located inside the cylinders of PVP (Fig.1) after deposition of the film by spin-coating.[1] Increasing the initial amount of gold precursors allows the formation of bigger AuPs (d=4 nm). The seeded-growth of the pre-formed AuNPs was also achieved in order to get bigger AuNPs (d=8 nm) with plasmon resonance properties. This method was found more efficient in order to get bigger nanoparticles with a low quantity of gold precursor. The presence of AuNPs in the PVP domains disturbs the organization of the parallel cylinders, while it swells the PVP domains in the case of the perpendicular cylinders without changing their orientation. The formation of AuNPs inside a copolymer was also performed by radiolysis, through the irradiation of the copolymer solution and the copolymer film, both containing the gold salt, and led to similar results. The presence of plasmonic AuNPs of small diameter (~3-4 nm) was evidenced in both cases. GISAXS measurements are presented to characterize and compare the films order before and after gold inclusion, and help proving that cylinder are perpendicular to the substrate through the entire thickness. If time allows, first optical characterizations of the polymer-gold films will be presented.

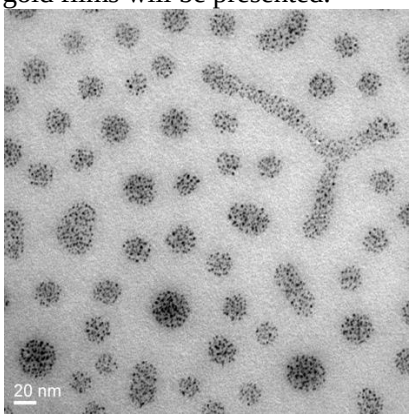

Fig. 1: Top view by TEM of a cylindrical phase of polymer where gold nanoparticles are exclusively included in cylinders

REFERENCES:

1. F. Aubrit, F. Testard, A. Paquirissamy, F. Gobeaux, X. Wang, F. Nallet, P. Fontaine, V. Ponsinet, & P. Guenoun, Ligand-free synthesis of gold nanoparticles incorporated within cylindrical block copolymer films, *Journal of Materials Chemistry C*, **6**, 8194-8204 (2018)