



HAL
open science

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

Florian Aubrit, Fabienne Testard, Aurélie Paquirissamy, Frédéric Gobeaux, Xuan Wang, Frédéric Nallet, Philippe Fontaine, Virginie Ponsinet, Patrick P. Guenoun

► To cite this version:

Florian Aubrit, Fabienne Testard, Aurélie Paquirissamy, Frédéric Gobeaux, Xuan Wang, et al.. Ligand-free synthesis of gold nanoparticles incorporated within oriented cylindrical block copolymer films. European Polymer Congress 2019, Jun 2019, Heraklion, Greece. cea-02328383

HAL Id: cea-02328383

<https://cea.hal.science/cea-02328383>

Submitted on 23 Oct 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

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

Florian Aubrit,^{1,2} Fabienne Testard,¹ Aurélie Paquirissamy,¹ Frédéric Gobeaux,¹ Xuan Wang,² Frédéric Nallet,² Philippe Fontaine,³ Virginie Ponsinet,² Patrick Guenoun,^{1,*}

¹LIONS, NIMBE, CEA, CNRS, Université Paris-Saclay, CEA-Saclay F-91191 Gif-sur-Yvette Cedex

²Centre de Recherche Paul Pascal, Université de Bordeaux, UPR CNRS 8641, Pessac

³Synchrotron SOLEIL, L'Orme des Merisiers, Saint-Aubin-BP 48, F-91192 Gif-sur Yvette Cedex

* E-mail: patrick.guenoun@cea.fr

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 synthesized 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.

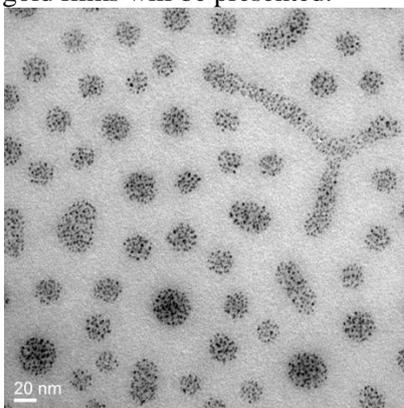


Fig. 1: Top view by TEM of a cylindrical phase of polymer where gold nanoparticles are exclusively included in cylinders

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)