Plasmonic Mesoporous Composites as Molecular Sieves for SERS Detection

Vanesa López-Puente[1], Sara Abalde-Cela[1],Paula C. Angelomé[1,2], Ramón Álvarez-Puebla[1,3,4], Luis M. Liz-Marzán[1,5,6]

[1] *Departamento de Química Física, Universidade de Vigo, 36310 Vigo, Spain*
[2]*Gerencia Química, Centro Atómico Constituyentes, Comisión Nacional de Energía Atómica, 1650 San Martín, Buenos Aires, Argentina*
[3] *ICREA, Passeig Lluís Companys 23, 08010 Barcelona, Spain*
[4] *Universitat Rovira i Virgili, Avda. Països Catalans, 2643007 Tarragona, Spain*
[5] *CIC biomaGUNE, Paseo de Miramón 182, 20009 Donostia - San Sebastián, Spain*
[6] *Ikerbasque, Basque Foundation for Science, 48011 Bilbao, Spain*
vanelope@uvigo.es

Abstract

We introduce a new composite material formed by a mesoporous thin film containing a submonolayer of Au nanoparticles covered with a mesoporous thin film, stable under biological conditions, which can act as a molecular sieve by size exclusion and avoid the contamination of the SERS spectra of small molecules[1]. The analysis of biological fluids by SERS is severaly restricted due to the complexity of such matrices regarding the high amount of different molecules they contain. The synthetic procedure is based on a two-step protocol[2] comprising the deposition of a mesoporous film on a sub-monolayer of gold spheres on glass and subsequent seeded growth of tips on the initial spherical nanoparticles, to improve the SERS efficiency of the material. A proof-of-concept is presented to demonstrate the size exclusion capability of the mesoporous films using BSA as biological medium system and 4-nitrobenzenethiol as standard Raman molecular probe. The results clearly demonstrate that titania mesoporous thin films can act as a molecular sieve in biological media, preventing the diffusion of large molecules (proteins) while allowing the diffusion of small molecules that can be detected by SERS spectroscopy (Figure1).

References

[1] López-Puente, V.; Abalde-Cela, S.; Angelomé, P. C.; Alvarez-Puebla, R. A.; Liz-Marzán, L. M. Plasmonic Mesoporous Composites as Molecular Sieves for SERS Detection. The Journal of Physical Chemistry Letters **4**, (2013), 2715-2720.
[2] Angelome, P. C.; Pastoriza-Santos, I.; Perez-Juste, J.; Rodriguez-Gonzalez, B.; Zelcer, A.; Soler-Illia, G. J. A. A.; Liz-Marzan, L. M. Growth and branching of gold nanoparticles through mesoporous silica thin films. Nanoscale **4**, (2012), 931-939.

Figures

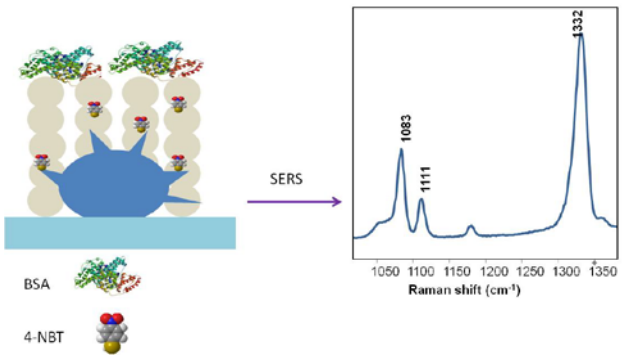

Figure1. Composite material comprising branched gold nanoparticles embedded in mesoporous thin films, which can act as a molecular sieve to avoid signal contamination in biological medium.