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NUMERICAL CALCULATIONS OF OPTICAL EFFICIENCIES, LOCAL ELECTRIC FIELD AND RADIATION PRESSURE OF POROUS DIELECTRIC SPHERES

Dielectric spheres made of polymethylmethacrylate, polystyrene or silicon dioxide, with diameters ranging from a few to several hundred nanometers, are commonly used as building-blocks of artificial opals or as templates for inverse opals. In particular, porous silica spheres have also been proposed as substrates for metal nanoparticles for SERS applications [1] . In this work, we have explored the effect of size and pore distribution on the optical response of the spheres. We used the discrete dipole approximation model to study a sphere with cylindrical mesopores. The diameter of the spheres was varied from 200 nm to 500 nm. A wavelength-independent refractive index of 1.46 was employed. The simulated optical response was compared with that obtained using effective medium theories. The radiation pressure on the spheres with different porosities is shown. The behavior of the electric field inside the pores when the latter are occupied by air or water is also shown. The results are of great importance for the applications of the dielectric spheres as gas sensors, molecular sensors or carriers.

Keywords

porous SiO2, DDA, near electric field, extinction, radiation pressure

Reference

[1] P. de León Portilla, E. Sánchez-Mora and A. L. González, Influence on SERS enhancement factor of the components of an artificial opal loaded with metal NPs: A systematic study, Curr. Appl. Phys. 39 (2022) 248-257. https://doi.org/10.1016/j.cap.2022.05.003

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Author approval

I confirm

Author will attend

I confirm

Author: GONZALEZ RONQUILLO, Ana Lilia (Instituto de Física, Benemérita Universidad Autónoma de Puebla, Av San Claudio y Blvd. 18 Sur, Col, San Manuel, 72570, Puebla, Pue., México.)

Co-authors: Dr SÁNCHEZ MORA, Enrique (Instituto de Física, Benemérita Universidad Autónoma de Puebla, Av San Claudio y Blvd. 18 Sur, Col, San Manuel, 72570, Puebla, Pue., México.); Dr DE LEÓN PORTILLA, Paulina (Instituto de Física, Benemérita Universidad Autónoma de Puebla, Av San Claudio y Blvd. 18 Sur, Col, San Manuel, 72570, Puebla, Pue., México.)

Presenter: Dr DE LEÓN PORTILLA, Paulina (Instituto de Física, Benemérita Universidad Autónoma de Puebla, Av San Claudio y Blvd. 18 Sur, Col, San Manuel, 72570, Puebla, Pue., México.)

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