Fluorescence of bare and dye-impregnated opals

F. Geobaldo, D. Santamaria Razo, F. Frascella, A. Venturello
Materials Science and Chemical Engineering Department – Polytehcnical University of Torino, C.so Duca degli Abruzzi 24 Torino (Italy).
E. Descrovi, A. Chiodoni, C. Ricciardi, F. Giorgis
Materials and Microsystems Laboratory χLab - Physics Department – Polytehcnical University of Torino, C.so Duca degli Abruzzi 24 Torino (Italy).
G. Viscardi, C. Barolo
Department of Inorganic, Chemical-Physics and Material Chemistry, University of Torino, Via P. Giuria 7 Torino (Italy)

Nowadays, the control of spontaneous emission in mesoscopic structures such as microcavities and photonic crystals, stimulated noticeable interest both from fundamental and technological point of view [1].

In this work, we report on modification of the fluorescence emission of a cyanine dye embedded in three-dimensional solid-state photonic crystals exhibiting stop bands in the visibile-near IR range.
Both direct Silica-based opals and inverse Silicon-based opals obtained by dip-coating and CVD Silicon infiltration respectively [2], are carefully studied by high resolution FESEM and Laser Scanning Confocal Optical Microscopy checking the morphological quality, while variable angle reflectance spectroscopy yields the linear optical response.
Fluorescence spectroscopy is performed on direct and inverse structures impregnated with engineerized cyanines in order to give an insight on the photon density of states redistribution which yields emission inhibition/suppression and changes in the directionality emission, in particular for the high index contrast inverse opals, which allow the formation of a complete photonic band gap.
In direct opals, cyanines are introduced at several synthesis steps such as during the TEOS hydrolysis concerning with the nanospheres growth and during the opal self-assembling optimizing the infiltration homogeneity.

Besides dye infiltration, fluorescence of Silica synthesized by sol-gel methods is used as efficient intrinsic source inside of the periodic structures. Actually, intense emission can be obtained suitably operating with the chemical reagents. Although the origin of the Silica fluorescence is still under debate (defect mechanism and charge transfer mechanism can be foreseen), our results demonstrate the possibility to modulate the emission range, which can be matched with respect to the opal photonic pseudo-gap.

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[2] L. Pallavidino, D. Santamaria Razo, F. Geobaldo, F. Giorgis et al., *J. of Non-Cryst. Solids*, **2**, 45 (2006).