Synthesis, characterization and modelling of direct and inverse opals

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We present results on the synthesis of Silica-based direct opals obtained by dip-coating technique starting from nanospheres with controlled diameter ranging from 150 nm up to 700 nm. The templates were infiltrated with Silicon by Low Pressure Chemical Vapour Deposition and the Silica matrix was removed by Reactive Ion Etching combined with HF etching, obtaining Si-based inverted opals. The quality of the 3D structures was checked by Raman spectroscopy, Atomic Force and Scanning Electron Microscopies, carefully analysing the presence of cracking and stacking faults. Optical characterizations were performed by stationary photoluminescence for the analysis of the influence of the PBG on the spontaneous emission and variable-angle reflectance aimed at obtaining the photonic bands. The optical measurements on direct and Silicon-infiltrated opals show the formation of PBGs, which tend to evolve towards an angular-independent, complete PBG for the inverse opal structure. Moreover, they show spectral features related to diffraction effects taking place within the photonic crystal. The interpretation is supported by calculations of photonic bands, as well as reflection and diffraction spectra, for the investigated structures.

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