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Synthesis pmma-gold core-shell based metallodielectric photonic crystals as substrates for surfaceenhanced raman spectroscopy

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The so-called bottom-up colloidal synthesis of photonic band gap (PBG) materials or photonic crystals (PhCs) has attracted considerable interest over the top-down approaches due to the relatively simple processing steps involved, the potential for large area sample production and the relatively low-costs associated with this approach for the fabrication of complex 3-dimensional (3D) structures1. Accordingly, this research focuses on the use of this bottom-up approach in the fabrication of polymeric colloidal PhCs and their subsequent modification. Poly(methyl methacrylate) (PMMA) was used both as a host material and as a crystal template in order to produce opals, inverse opals or 3D metallodielectric photonic crystal (MDPC) structures. The fabrication of MDPCs with Au nanoparticles attached to the PMMA spheres, referred to as PMMA@Au coreshell particles, is described. These have potential for use in the creation of sensors or so-called complete PBG materials. The incorporation of metallic nanostructures such as Au, is interesting because such nanostructures possess surface plasmon resonances (SPRs), which manifest as additional absorption bands, when the incident photon frequency is resonant with the collective oscillation of the conduction electrons. Various alternative procedures for the fabrication of PhCs and MDPCs are described and preliminary results on the use of an Au-based MDPC for surface-enhanced Raman scattering (SERS) are presented. These preliminary results suggest perhaps a threefold increase of the Raman signal with the MDPC as compared to the bare PMMA PhC.

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