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Surface-enhanced Raman scattering in ETPTA inverse photonic crystals with gold nanoparticles

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The main concepts of our previous articles

Ref. 23: M. Ashurov, A. Baranchikov, S. Klimonsky. Photonic crystal enhancement of Raman scattering. *Phys. Chem. Chem. Phys.*, 2020, **22**, 9630.

The main concept of the article is to show that photonic crystals have a significant potential for enhancing Raman scattering of light. ETPTA inverse opal films filled with methylene blue analyte were examined and it was shown that the highest enhancement factor, over 50, is achieved when the stop band center coincides with the Raman laser wavelength.

Furthermore, the procedure for inverting opal films using the photocurable resin ETPTA is described in detail.

Ref. 31: S. Klimonsky, A. Baranchikov, V.N. Lad, E. Eremina, A. Garshev, A. Kuznetsov, F. Jalolov, P. Demidovich. Photonic and plasmonic effects in inverse opal films with Au nanoparticles. *Photonics and Nanostructures - Fundamentals and Applications*, 2021, **43**, 100899.

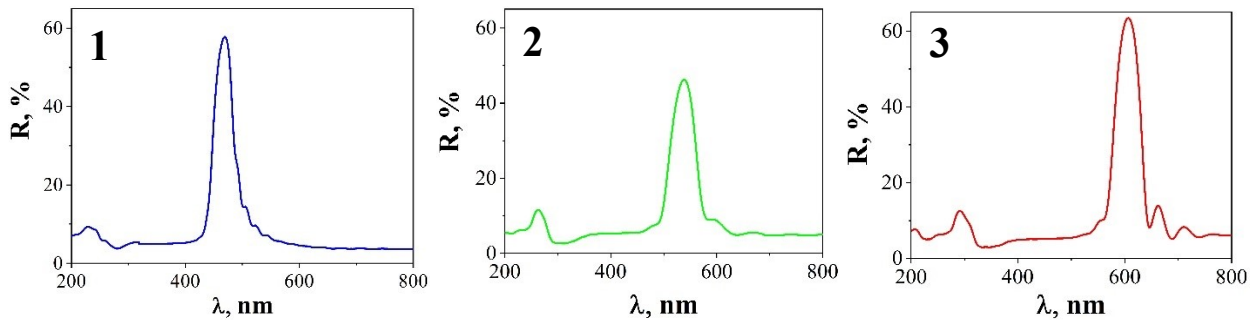
The first goal of this study was to develop methods for introducing the required concentrations of Au nanoparticles (NPs) that would not cause degradation of the photonic crystal properties of inverse opal films. Two methods of Au NPs incorporation based on multiple infiltration of water-ethanol solution of Au NPs were proposed. In method 1, the film was immersed in the solution for 15 minutes, then dried in air, washed to remove products of gold reduction, dried again, and the whole cycle was repeated the required number of times (up to 50) depending on the desired surface concentration of gold (up to 0.7 $\mu g/mm^2$). Method 2 differed by the absence of the first drying after the gold solution infiltration. In both cases, the final procedure was to lightly wipe the films using cotton wool with alcohol, to remove gold NPs from the surface.

The second goal of the work was to study the synergy of photonic and plasmonic effects in opaline films with Au NPs.

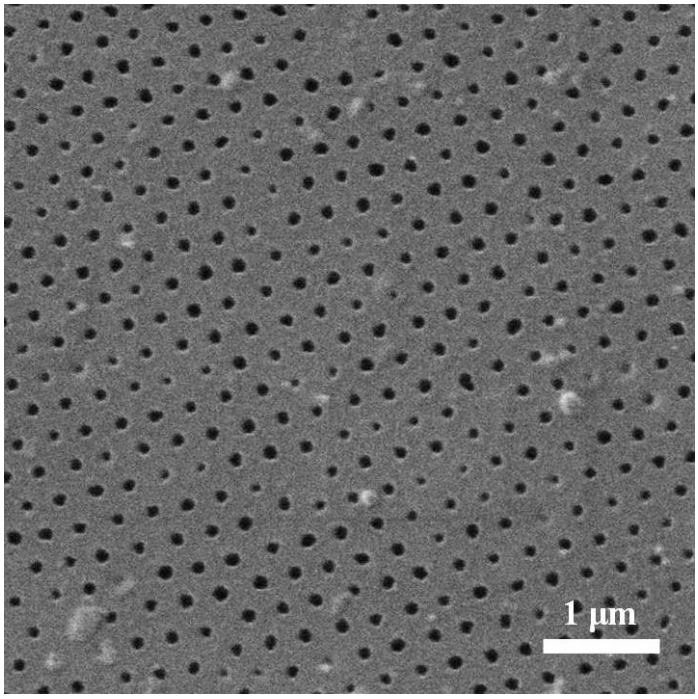
Ref. 36: M.S. Ashurov, T. Bakhia, B.M. Saidzhonov, S.O. Klimonsky. Preparation of inverse photonic crystals by ETPTA photopolymerization method and their optical properties. *J. Phys.: Conf. Ser.*, 2020, **1461**, 012009.

Inverting opal films using the photocurable resin ETPTA is described. The structural and optical properties of the obtained samples are investigated. Their use for sensing water-ethanol mixtures was tested.

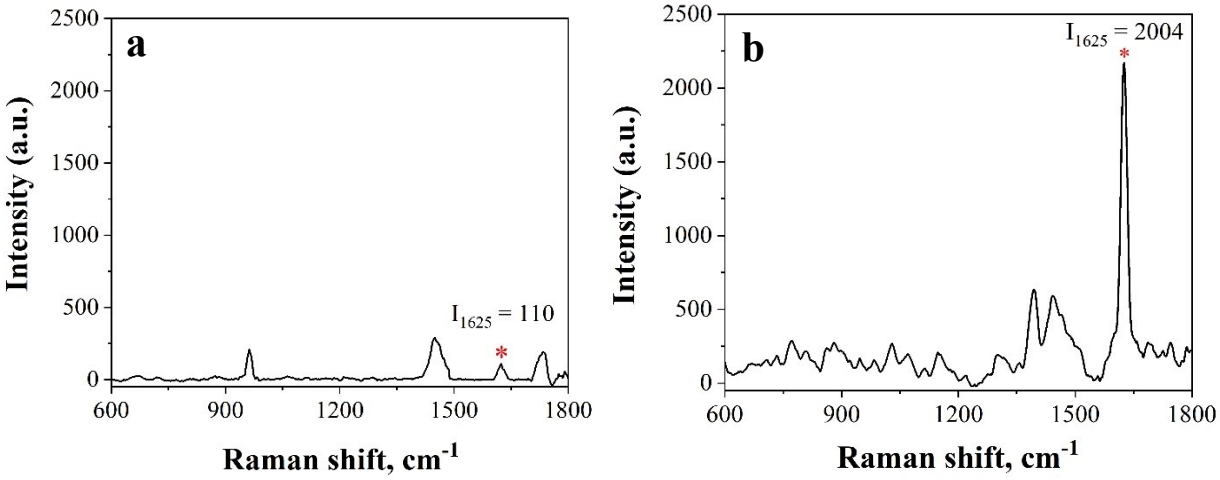
Supplementary Figures



S1. Reflectance spectra of investigated samples before gold infiltration. The numbers on the panels correspond to the numbers of the samples in Table 1. Two peaks associated with the first and second stop-bands are clearly visible.



S2. SEM image of the surface of sample 2. Gold NPs were removed from the surface using cotton wool with alcohol.



S3. Raman spectra for sample 2 with MB adsorbed from $C = 10^{-6}$ M solution (a) and for the reference sample of 0.2 M MB aqueous solution into a quartz cuvette (b). The height of the main MB peak is 110 and 2004 counts for (a) and (b), respectively.