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Hybridization of Surface Plasmon Polariton and Photonic Cristal Defect Modes in Bragg Mirror with periodical profiled metal film

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Nowadays, the new concepts are being searched actively to obtain complex nanomaterials with controlled optical properties. A major focus of these researches is concentrated on idea of combining the properties of photonic and plasmonic nanostructures. It is known that the defect modes (DM) appear in the case of periodicity violation in the photonic crystals (PhC). For example, the excitation of PhC defect mode can be realized in the PhC terminated by a metal film. The position of DM highly depends on geometrical and optical properties of the PhC and its boundaries [1]. Moreover, the presence of metal film provides the excitation of the surface plasmon-polariton (SPP). But for stratified multilayer structures, the dispersions of these modes exist in different regions of the light cone, because the DM is radiative, whereas the SPP is non-radiative mode. Therefore, the main purpose of this report is the determination of conditions for the interaction between SPP and DM in the case of periodically modulated metal film when the positions of SPP and DM are in the same spectral-angular region.

The simulations of the light-matter interaction in 1D PhC terminated by a metal film are based on the curvilinear coordinates transformation method in the framework of the differential formalism [2]. The 1D PhC is formed by Bragg mirror that consists of 5-folds sandwich of two quarter-wavelength dielectric layers with refractive indices of 1.47 and 2. A gold film with a thickness of 30 nm is sine profiled with a period of 700 nm and a profiling depth of 30 nm. It was demonstrated the possibility of the interaction between DM and SPP that leads to split of their dispersions. In this case, the spatial localization of DM is improved by a more strong spatial localization of SPP and we can talk about hybridization of these modes.

1. *Romanov S. et al.* Hybrid Colloidal Plasmonic-Photonic Crystals// Advanced Materials.– 2011. – **23**. – P.2515-2533.
2. *Korovin A.* Improved method for computing of light-matter interaction in multilayer corrugated structures // JOSA A – 2008. – **25** – P.394-399.