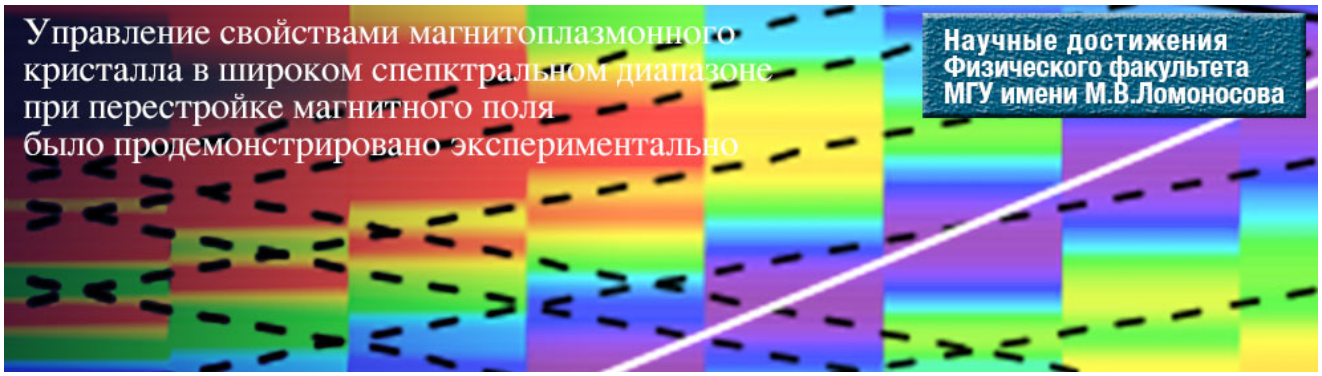
The tunable magnetic-field controlled behaviour of magnetoplasmonic crystals in a wide spectral range has been demonstrated experimentally



Researchers from the Faculty of Physics, Lomonosov Moscow State University, in collaboration with their colleagues from Minsk, Belarus, experimentally studied optical and magnetooptical effects in magnetoplasmonic crystals and demonstrated the tunable magnetic-field controlled behaviour of these crystals in a wide spectral range.

Magnetoplasmonic crystals (MPC) attract much attention due to their unique and pronounced ability to control the light flow. One of the efficient MPC compositions is the combination of a dielectric magnetic film with a thin perforated metal layer on top. It was demonstrated that MPC of such a type supports the resonant excitation of surface plasmon polaritons (SPP) with a relatively long SPP propagation length and reveals a strong

magneto-optical response introduced by garnet films. This allows for a magnetic field control over the SPP excitation at the metal/garnet interface. An important point here is that the quality of the interfaces between the adjacent metal and dielectric layers should be smooth and free of defects. This restricts the number of accessible techniques for the MPC fabrication.

In most of the experimental papers methods involving the electron beam lithography were used to make the Au/gold MPC on a gallium gadolinium garnet (GGG) substrate. It was shown that such a structure supports the excitation of the SPP modes localized on two metal surfaces, as well as the waveguide (WG) modes in the dielectric slab. The necessity in use of a template limited the variety of structures that have been studied; besides, the minimal thickness of the gold layer in such MPC was about 70 nm.

In the work of scientists from Physics Department of MSU performed in collaboration with their colleagues from Scientific-Practical Materials Research Centre , Minsk, Belarus, optical and magnetooptical effects in magnetoplasmonic crystals (MPC) were studied. The MPCs were formed by a 1D gold grating on top of a magnetic garnet layer made by a novel method of combined ion-beam etching technique. We demonstrate that the proposed method allows to make high-quality MPC. It is shown that MPC with a 30-40 nm thick perforated gold layer provides an effective excitation of two surface plasmon-polariton modes and several numbers of waveguide modes in the garnet layer. An enhancement of the transversal magneto-optical effect up to the value of 1% is observed for all types of resonant modes that propagate in the magnetic layer, due to magnetic-field control over the mode excitation, which is promising for future photonic devices.

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excitation of multiple waveguide and plasmon modes”, Opt. Express 22 (15) 17762-17768 (2014).