NOVEL EFFECTS AND FUNCTIONALITIES IN SUBWAVELENGTH PHOTONIC AND PLASMONIC STRUCTURES

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Currently, within our theoretical research under the Czech Science Foundation and COST projects, we have investigated various novel effects and functionalities, connected with subwavelength (SW) photonic and plasmonic (Nano)structures. Based on the development and application of numerical methods for the analysis of the interaction of the electromagnetic field with such structures (mainly Fourier modal methods), we have recently studied several interesting and potentially perspective problems: (1) subwavelength grating (SWG) waveguide-based structures, such as SWG Bragg and transmission narrow-band filters, (2) novel magnetooptic (MO) guiding structures with non-reciprocal properties, (3) parity-time (PT) gain / loss symmetric guiding and resonant structures, (4) surface plasmonic waves in graphene-based structures, and (5) nonlocal-response resonances in nanoplasmonic structures. In this contribution, we present and discuss several results selected from these problems. Concerning (2) activities, based on magnetooptic Fourier modal method (MOaRCWA) simulations, both in 2D in 3D, we have studied the one-way (nonreciprocal) propagation of magnetoplasmons in plasmonic nanostructures, such as highly-dispersive polaritonic InSb material, within the THz spectral region, under an external magnetic field (mainly in the Voigt configuration). Further, concerning (5) activities, our recent results of both analytical and numerical approaches incorporating nonlocal behavior of plasmonic nanostructures, which characteristic dimensions of such structures have scaled down, will be discussed. Concerning the analytical approach, the hydrodynamical model with generalized (viscose and Landau) damping, generalizing the standard Abajo's nonlocal model, has been applied to study nonlocal responses of gold and silver nanoparticles, in dielectric surrounding media (such as air or water). In parallel, as an alternative (and more general) approach, based on our previous rich experience with Fourier modal methods, we have considered and developed the extension of the RCWA technique capable of treating nonlocal response numerically (NonLocRCWA), for more general structures.