Anisotropic plasmonic metamaterials for nanophotonic applications

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Abstract

We will discuss active hyperbolic metamaterials based on assembly of alligned plasmonic nanorods. The possibility to achieve controlled gain, loss and nonlinear effects associated with metamaterial constituents will be overviewed. Polarisation manipulation with and its nonlinear control in the metamaterials will also be discussed. Nanorod metamaterials provide flexible and universal platform for designing active nanophotonic components.

Plasmonic crystals, waveguiding components and metamaterials have recently been introduced to enhance various active functionalities based on electric, magnetic, acoustic and optical control signals. Active and tuneable plasmonic components are required for development of numerous applications in integrated photonic circuits, in high-density data storage applications as well as bio- and chemical sensing in lab-on-a-chip systems. All-optical control is especially interesting as it allows achievement of fast response and variety of approaches to be used, including nonlinear response and spontaneous and stimulated emission effects.

Recently, plasmonic metamaterials have been developed based on arrays of aligned gold nanorods which exhibit hyperbolic dispersion. They provide a flexible platform with tuneable resonant optical properties across the visible and telecom spectral range. Such metamaterials, with a controllable and engineered plasmonic response, can be used instead of conventional plasmonic metals for designing plasmonic waveguides, plasmonic crystals, label-free bio- and chemo-sensors and in the development of nonlinear plasmonic components with high effective nonlinearities [1-13]. In this talk, we will overview fundamentals and applications of anisotropic plasmonic metamaterial for controlling both intensity and polarization of light, including active control with temperature, loss/gain-induced anisotropy and magneto-optical properties. Plasmonic metamaterials allow one to achieve polarization manipulation in deep subwavelngth thin structures in both reflection and transmission, otherwise impossible with naturally occurring anisotropic materials.

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