Switchable plasmonic surfaces

Bernhard Atorf[1]*, Simon Friesen[1], Roman Rennerich[1], Hoda Rasouli[1], Holger Mühlenbernd[1], Bernhard J. Reineke[1], Thomas Zentgraf[1], and Heinz Kitzerow[1]

[1] *Center for Optoelectronics and Photonics Paderborn (CeOPP), University of Paderborn, Warburger Str. 100, 33098 Paderborn (DE)*

Metamaterials and metasurfaces can interact with waves in extremely unusual ways. They are composed of three- or two-dimensional arrangements of objects that are smaller than the wavelength under consideration. Their effective material parameters are not only governed by the bulk properties of the compounds composing them, but depend to a large extent on the geometry of these objects with subwavelength size. Previous studies on tunable metamaterials containing liquid crystals have mainly focused on utilizing the calamitic nematic phase. Here, a switchable metasurface composed of plasmonic split ring resonators and a polymer-stabilized liquid crystal blue phase is presented (Fig. 1) [1]. Also the applicability of liquid crystals for switchable holograms with high diffraction efficiency based on geometrical metasurfaces [2] was investigated. Preliminary results [3] will be shown.

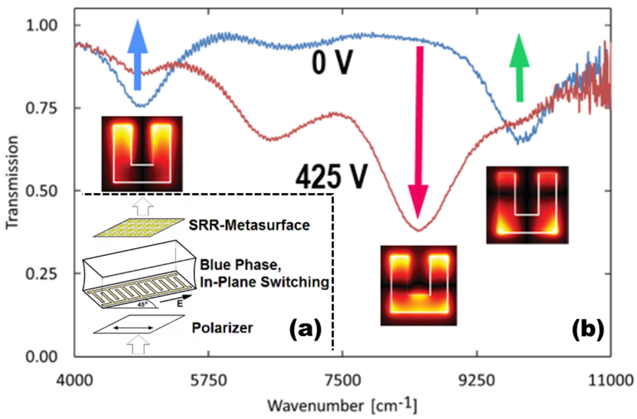

Figure 1: (a) Experimental setup: A metasurface composed of split ring resonators (SRR) is exposed to infrared (IR) radiation transmitted through an in-plane switching (IPS) cell filled with a polymer-stabilized blue phase. The latter controls the state of polarization. (b) IR transmission spectra at different voltages. (Inset: spatial distribution of the field amplitudes of the respective resonant modes of the SRR) [1].

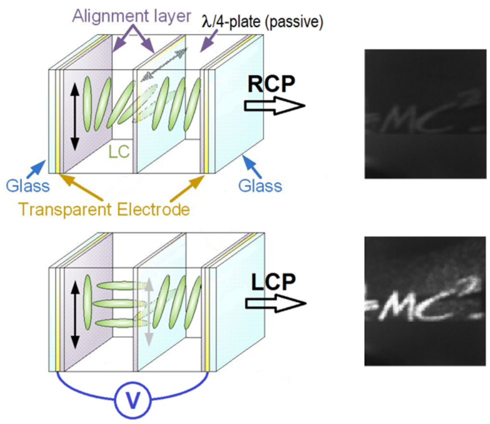

Figure 2: Liquid crystal cell transforming linearly polarized light to right circularly polarized light (RCP) if no voltage is applied or to left circularly polarized light (LCP) if a voltage of a few volts is applied. To the right: Reconstruction of a hologram from a geometric metasurface as described in Ref. [2] by means of the integrated RCP/LCP electro-optic switch at 0V (RCP) and 10 V (LCP), respectively [3].

References

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[2] G. Zheng, H. Mühlenbernd, M. Kenney, G. Li, T. Zentgraf, and S. Zhang, Nature Nanotechnology **10**, 308 (2015)

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**Corresponding author e-mail: Bernhard.Atorf@upb.de*