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Dispersion analysis in plasma based switchable metamaterial structures JAN TRIESCHMANN, THOMAS MUSSENBROCK, Institute for Theoretical Electrical Engineering, Ruhr-University Bochum — Artificially designed materials (metamaterials) are well known for their unique possibilities of manipulating electromagnetic fields. Frequency filters, negative-refraction as well as waveguide devices have been demonstrated. As these structures are mostly implemented by statically structured materials, there has been only limited capability of switching these devices. As proposed by Sakai et al. [1] this limitation can be potentially overcome by the use of micro plasmas. We investigate the dispersion behavior of different material structures. These structures can be made of metal/dielectric elements, but most importantly switchable micro plasmas. The dispersion analysis is done by means of FDTD simulations, coupled to auxiliary differential equations for treatment of the plasma discharges. The frequency response of the structures is analyzed by short pulse excitation and subsequent Fourier transform analysis. Finally, from the obtained dispersion relation we draw the conclusion towards the transmission behavior of the structures with respect to frequency selective applications. We are able to show that micro plasmas employed as photonic crystals enable for e.g., photonic band-gap (PBG) properties along with their unique switching capability.

[1] O. Sakai et al., Appl. Phys. Lett. 87, 241505 (2005).

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