

Abstract Submitted
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Metamaterials with gain and interpretation of transmission in pump-probe experiments¹ THOMAS KOSCHNY, Ames Laboratory and Dept. of Phys. and Astronomy, Iowa State University, Ames, Iowa 50011, U.S.A., ZHIXIANG HUANG, Ames Lab and Dept. of Phys., Iowa State Univ., Ames, Iowa 50011, U.S.A . and Anhui Univ., China, COSTAS M. SOUKOULIS, Ames Lab and Dept. of Phys., Iowa State Univ., Ames, Iowa 50011, U.S.A . and IESL, FORTH, Heraklion, Greece — We establish a new approach for pump-probe simulations of metallic metamaterials coupled to the gain materials. It is of vital importance to understand the mechanism of the coupling of metamaterials with the gain medium. Using a four-level gain system, we have studied light amplification of arrays of metallic split-ring resonators (SRRs) with a gain layer underneath. We find that that the differential transmittance $\Delta T/T$ can be negative for SRRs on the top of the gain substrate, which is not expected, and $\Delta T/T$ is positive for the gain substrate alone. These simulations agree with pump-probe experiments and can help to design new experiments to compensate the losses of metamaterials. We numerically investigate loss compensation and transmission in pump-probe experiments in resonant metamaterials with gain using an FDTD algorithm coupled to semiclassical rate equations. We explain experimentally observed negative differential transmission by gain-dependent impedance.

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