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Title:Mapping inter-element coupling in metamaterials: Scaling down to infrared
Authors:Tatartschuk, E. (1); Gneiding, N. (1); Hesmer, F. (2); Radkovskaya, A. (3); Shamonina, E. (4)
Author affiliation:(1) Erlangen Graduate School in Advanced Optical Technologies, University of Erlangen-Nuremberg, 91052 Erlangen, Germany; (2) Department of Physics, University of Osnabrück, 49069 Osnabrück, Germany; (3) Magnetism Division, Faculty of Physics, M. V. Lomonosov Moscow State University, Leninskie Gory, Moscow 119992, Russia; (4) Optical and Semiconductor Devices Group, Electrical and Electronic Engineering (EEE) Department, Imperial College, Exhibition Road, London SW7 2BT, United Kingdom
Corresponding author:Tatartschuk, E.
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Abstract:The coupling between arbitrarily positioned and oriented split ring resonators is investigated up to THz frequencies. Two different analytical approaches are used, one based on circuits and the other on field quantities that includes retardation. These are supplemented by numerical simulations and experiments in the GHz range, and by simulations in the THz range. The field approach makes it possible to determine separately the electric and magnetic coupling coefficients which, depending on orientation, may reinforce or may cancel each other. Maps of coupling are produced for arbitrary orientations of two co-planar split rings resonant at around 2 GHz and then with the geometry scaled down to be resonant at around 100 THz. We prove that the inertia of electrons at high frequencies results in a dramatic change in the maps of coupling, due to reduction of the magnetic contribution. Our approach could facilitate the design of metamaterials in a wide frequency range up to the saturation of the resonant frequency. © 2012 American Institute of Physics.
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