Dichroism, chirality, and polarization eigenstates in Babinet nanoslot-dimer membrane metamaterials

We present a detailed theoretical description of the optical properties of planar metamaterials comprising a metal membrane patterned with openings (microslots) arranged in closely located couples (dimers). Using the covariant coupled-dipole approach, the effective material tensors of such a metamaterial are recovered, and contributions responsible for elliptical dichroism and optical activity are identified. Polarization conversion properties of II-shaped and V-shaped dimers are determined and explained in terms of elliptically polarized eigenmodes of the metamaterial. Good agreement with direct numerical simulations is demonstrated. The results obtained are promising for the design of thin-film frequency selective polarization shapers for terahertz waves.

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