Chiral Metamaterials in Terahertz Band

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***Abstract*—Chiral metamaterials have emerged as a promising platform for tailoring electromagnetic responses beyond the limits of naturally occurring materials. In this work, we present a systematic numerical study of three-dimensional (3D) helical structures and two-dimensional (2D) bilayer gratings in the terahertz (THz) regime, with the objective of enhancing circular dichroism (CD), optical rotation, and ellipticity. For the helical geometry, both completely filled and hollow configurations are analyzed using gold and pyrolytic carbon (PyC) as candidate materials. While gold exhibits strong CD in the 0.3–0.6 THz range, PyC is shown to provide comparable broadband responses in the 0.5–1 THz regime, highlighting its potential as a low-cost alternative and its fabrication advantages. In the hollow case, gold significantly outperforms PyC, achieving clear CD in the 0.7–1 THz band even with ultrathin metallic layers. In addition, a quasi-2D double-layer gammadion grating is investigated, where optimization of the interlayer separation yields an order-of-magnitude enhancement in rotation and ellipticity. These results demonstrate viable routes to engineer strong chiral responses in the THz band, offering pathways toward compact devices for THz imaging, sensing, and communication.**