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Terahertz dielectric anisotropy in randomly distributed, spatially coherent polymethacrylate microwire arrays fabricated by Stereolithography

Serang Park[1] · Yanzeng Li[1] · Susanne Lee[2] · Stefan Schöche[3] · Craig M. Herzinger[3] · Tino Hofmann[1,4]

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Abstract Fabricating terahertz (THz) optical components with tailored dielectric properties including scalable anisotropies via additive manufacturing is drawing substantial interest as it potentially offers a rapid, low-cost pathway for THz optical system development. Metamaterials composed of slanted columnar structures have been reported to exhibit anisotropic behaviors at THz frequencies, which may allow the design of novel optical components including filters and sensors for the THz frequency range. Here, we report on the anisotropic THz-optical response of stereolithographically fabricated polymethacrylate slanted columnar layers. The samples are composed of randomly distributed, spatially coherent polymethacrylate wires with a diameter of 100 μm and a length of 700 μm, which are tilted by 45° with respect to the surface normal of the substrate. Generalized spectroscopic ellipsometry is employed to obtain Mueller matrix spectra of these samples in the range from 210 to 350 GHz. A simple biaxial (orthorhombic) layer homogenization approach is used to analyze the THz Mueller matrix data obtained at different azimuthal orientations. Our observations confirm that randomly distributed, spatially coherent polymethacrylate wire arrays exhibit a strong anisotropic response. In conclusion, stereolithographic fabrication is introduced as an effective tool for fabricating metamaterials with anisotropic THz-optical properties.

E-mail: spark71@uncc.edu
1) Department of Physics and Optical Science, University of North Carolina at Charlotte, 9201 University City Blvd, Charlotte, NC, 28223
2) Harris Corp., Space and Intelligence Systems, 2400 Palm Bay Rd, Palm Bay, FL 32905
3) J. A. Woollam Co. Inc., 645 M Street, Suite 102, Lincoln, NE 68508
4) Department of Physics, Chemistry, and Biology (IFM), Linköping University, SE 581 83 Linköping, Sweden