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Angle-Resolved Mid-Infrared Spectroscopy of Gyroid Photonic Crystals EMIL T. KHABIBOULLINE, SIYING PENG, Applied Physics, California Institute of Technology, PHILIP HON, Nanophotonics and Metamaterials Laboratory, Northrop Grumman Aerospace Systems, RUNYU ZHANG, Department of Materials Science and Engineering, UIUC, HONGJIE CHEN, Applied Physics, California Institute of Technology, LUKE A. SWEATLOCK, Nanophotonics and Metamaterials Laboratory, Northrop Grumman Aerospace Systems, PAUL BRAUN, Department of Materials Science and Engineering, UIUC, HARRY A. ATWATER, Applied Physics, California Institute of Technology — Photonic topological insulators form a new class of materials with exciting properties. Theory has indicated that gyroid photonic crystals are photonic topological insulators. In this paper, we experimentally characterize the photonic properties of gyroid photonic crystals at mid-infrared wavelengths, using angle-resolved spectroscopy with coherent light from a quantum cascade laser tuned from 7.7 μm to 11.1 μm and focused onto a 100 μm $\times$ 100 μm spot. From measurements of reflection and transmission spectra over incidence angles, we construct the band structure of the photonic crystals. In this study, the photonic crystals are single and double gyroid made of amorphous silicon, with unit cell size of 5 μm, sitting on an intrinsic silicon substrate. Simulations predict band gaps for the single gyroid and Weyl points for the double gyroid. We compare results of angle-resolved spectroscopy experiments with simulations for nanofabricated gyroid structures and discuss the topological features observable in angle-resolved scattering.

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