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Gyroid photonic crystal with Weyl points: synthesis and mid-infrared photonic characterization SIYING PENG, EMIL KHABIBOULLINE, Applied Physics, California Institute of Technology, RUNYU ZHANG, Department of Materials Science and Engineering, UIUC, HONGJIE CHEN, Applied Physics, California Institute of Technology, PHILIP HON, LUKE SWEATLOCK, Nanophotonics and Metamaterials Laboratory, Northrop Grumman Aerospace Systems, PAUL BRAUN, Department of Materials Science and Engineering, UIUC, HARRY ATWATER, Applied Physics, California Institute of Technology — Weyl points are degenerate energy states resulting from crossings of linear bands in 3D momentum space. Unlike their 2D counterparts, Weyl points are bulk degenerate states that are stable to weak perturbation. The topological surface states associated with Weyl points exhibit unidirectional backscattering-immune transport. Double gyroid photonic crystals with a parity-breaking perturbation are predicted to possess Weyl points. We designed and synthesized single and double gyroid mid-IR photonic crystals composed of a-Si. We characterized them by mid-IR spectroscopy. We observed 100% reflection at 8μm for single gyroids with unit cell size of 5μm, in agreement with the predicted photonic bandgap seen in full-wave EM simulations. As the unit cell size of single gyroids changes to 6μm, the observed reflection peak shifted to 9μm, also agreeing with simulation. For double gyroids with unit cell size of 5μm, we observed a 20% decrease in reflection at 8μm, which could be explained by a new pair of states appearing within the bandgap from our simulation of double gyroids. We use angle-resolved mid-IR spectroscopy with a QCL to characterize Weyl points.

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