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Double gyroid photonic crystal: synthesis and mid-infrared photonic characterization SIYING PENG, Applied Physics, California Institute of Technology, RUNYU ZHANG, Department of Materials Science and Engineering, UIUC, EMIL KHABIBOULLINE, VITORIA BARIM, HONGJIE CHEN, Applied Physics, California Institute of Technology, PHILIP HON, JUAN GARCIA, 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
— Gyroids are triply symmetric and have surfaces containing no straight lines. Single gyroid (SG) photonic crystals have a large band gap, while double gyroids (DG) with P-breaking symmetry possess Weyl points and topologically non-trivial surface states. These topologically protected states give rise to backscattering immune unidirectional transport. We have synthesized and characterized the first mid-IR gyroid photonic crystals, including both SGs and DGs with Weyl points. Polymer gyroid scaffold was written by DLW, followed by ALD of Al_2O_3, polymer removal and conformally coating of a-Si. The resulting DGs have Weyl points at 8 m and k between 0.3-0.5π/a. Characterization of SG and DG have been performed by angle resolved mid-IR spectroscopy. The photonic bandstructure is constructed from angle resolved reflectance and transmittance spectra, all the way close to the light line. Constructed bandstructures from SGs exhibit a photonic bandgap. For DGs the bandstructures reveal defect photonic states emerging inside the bandgap. Strategies to observe protected surface states in DGs will be discussed.

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