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Hyperuniform Disordered photonic bandgap materials, from 2D to 3D, and their applications[1] WEINING MAN, Department of Physics and Astronomy, San Francisco State University, MARIAN FLORESCU, Advanced Technology Institute, University of Surrey, UK, SHERVIN SAHBA, Department of Physics and Astronomy, San Francisco State University, STEVEN SELLERS, Advanced Technology Institute, University of Surrey, UK — Recently, hyperuniform disordered systems attracted increasing attention due to their unique physical properties and the potential possibilities of self-assembling them. We had introduced a class of 2D hyperuniform disordered (HUD) photonic bandgap (PBG) materials enabled by a novel constrained optimization method for engineering the material's isotropic photonic bandgap. The intrinsic isotropy in these disordered structures is an inherent advantage associated with the lack of crystalline order, offering unprecedented freedom for functional defect design impossible to achieve in photonic crystals. Beyond our previous experimental work using macroscopic samples with microwave radiation, we demonstrated functional devices based on submicron-scale planar hyperuniform disordered PBG structures further highlight their ability to serve as highly compact, flexible and energy-efficient platforms for photonic integrated circuits. We further extended the design, fabrication, and characterization of the disordered photonic system into 3D. We also identify local self-uniformity as a novel measure of a disordered network's internal structural similarity, which we found crucial for photonic band gap formation.

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