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Disordered Hyperuniform Photonic Band Gap Materials MARIAN FLORESCU, Department of Physics, Princeton University, WEINING MAN, Department of Physics and Astronomy, San Francisco State University, PAUL CHAIKIN, Department of Physics, New York University, SALVATORE TORQUATO, Department of Chemistry, Princeton University, PAUL J. STEINHARDT, Department of Physics, Princeton University — Until recently, the only materials known to have complete photonic band gaps were photonic crystals, periodic structures, and it was generally assumed that long-range periodic order was instrumental in the band gap formation. We have shown that there exists a more general class of systems, called hyperuniform photonic structures, which exhibit large and complete photonic band gaps. This classification includes not only crystalline structures, but also non-crystalline materials, ranging from quasicrystals with crystallographically-forbidden rotational symmetries to isotropic, translationally-disordered structures. Remarkably, we find that the photonic band gaps in hyperuniform disordered structures are not only comparable to those found in photonic crystals, but also display a high degree of isotropy. These new materials possess unique photonic and physical properties that provide important advantages for applications. Our results show that hyperuniform disordered structures enable the realization of optical cavities with ultimate isotropic confinement of the electromagnetic radiation, lossless waveguides with arbitrary bending angles and flexible optical insulator platforms.

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