

Three-Dimensional Single Gyroid Photonic Crystals with a Mid-Infrared Bandgap (Supporting Information)

¹Siyong Peng, ²Runyu Zhang, ¹Valerian H. Chen, ¹Emil T. Khabiboulline, ²Paul Braun, ¹Harry A. Atwater

1. Applied Physics, California Institute of Technology
2. Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign

Optical constants of deposited materials

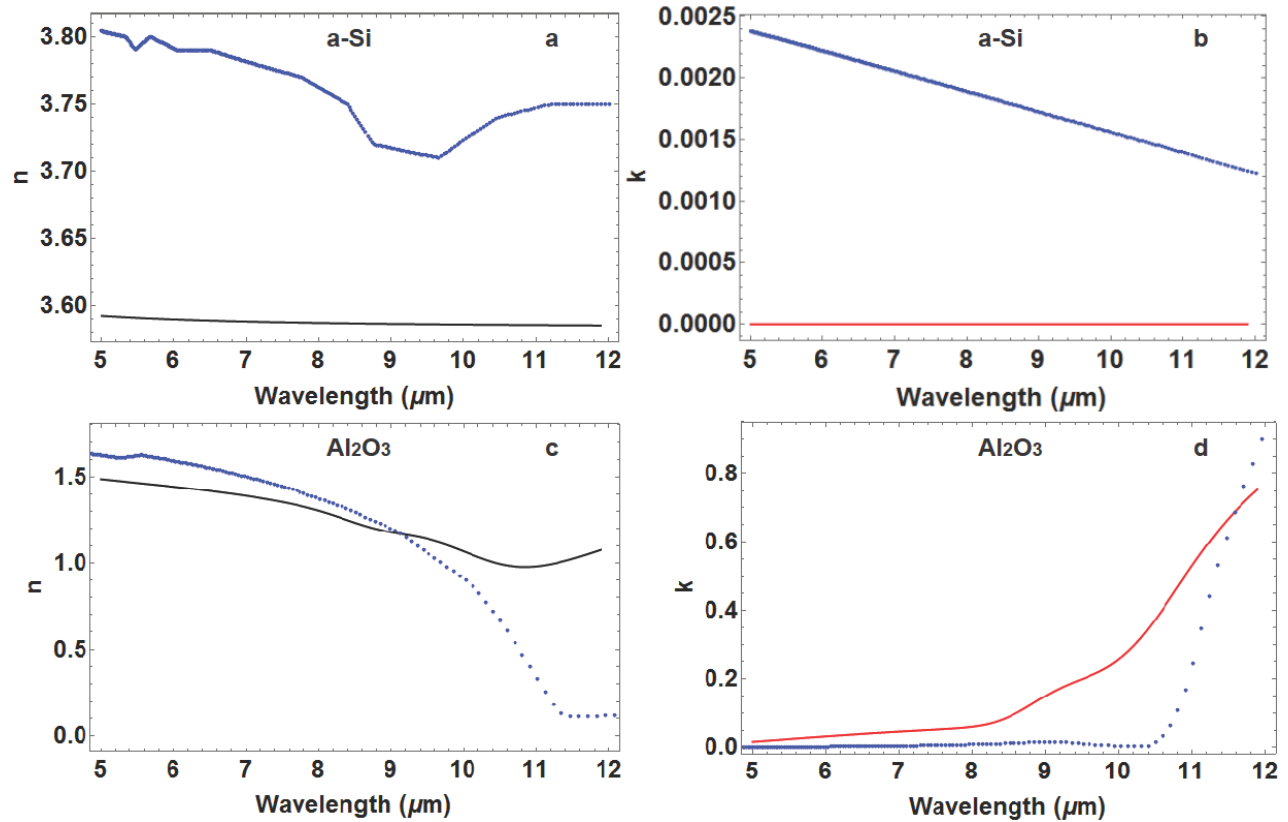


Figure S1 Optical constants at Mid-infrared wavelength. (a) measured real part of refractive index of a-Si (black solid line) and Palik's real part of refractive index of a-Si (blue dotted line) (b) measured imaginary part of refractive index of a-Si (red solid line) Palik's imaginary part of refractive index of a-Si (blue dotted line) (c) measured real part of refractive index of Al₂O₃ (black solid line) and Palik's real part of refractive index of Al₂O₃ (blue dotted line) (d) measured imaginary part of refractive index of Al₂O₃ and Palik's real part of refractive index of (blue dotted line)Al₂O₃

Psi (Ψ) and delta (Δ) data were measured using IR-VASE Mark II infrared variable angle spectroscopic ellipsometer, from a-Si/ Al_2O_3 films deposited on an intrinsic silicon substrate. Optical constants n and k were then obtained from psi (Ψ) and delta (Δ) using a three layer fitting model.

Fill fraction and discontinuity

$u(x,y,z)$	1.0	1.05	1.1	1.2	1.3	1.35	1.37	1.4	1.45
fill fraction	0.155	0.141	0.127	0.077	0.060	0.023	0.021	0.018	0.004

Table S1 $u(x,y,z)$ versus fill fraction for a solid single gyroid.

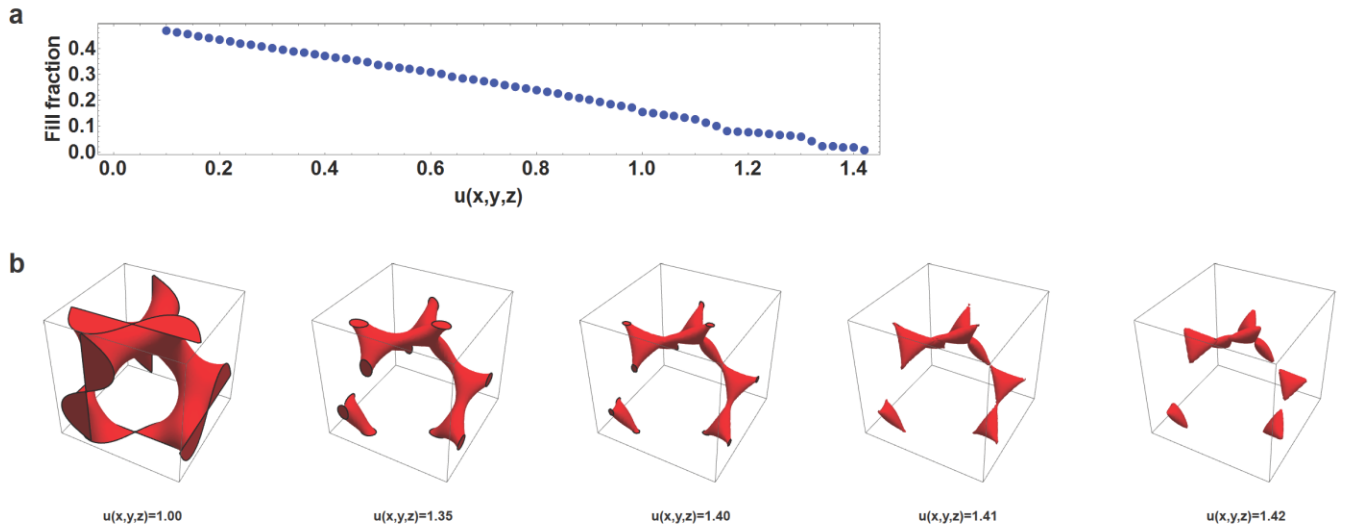


Figure S2 Single gyroid with different $u(x,y,z)$. (a) $u(x,y,z)$ versus fill fraction for a solid single gyroid (b) single gyroid with $u(x,y,z)=1.00, 1.35, 1.40, 1.41$ and 1.42 respectively

Fill fractions are calculated in correspondence to $u(x,y,z)$ for a solid single gyroid structure. Our fabricated structure consists of a-Si (100nm) / Al_2O_3 (40nm) /a-Si (100nm) is a hollow single gyroid structure with fill fraction of 0.104. The a-Si (100nm) / Al_2O_3 (40nm) /a-Si (100nm) layers have $u(x,y,z)$ values of 1.1, 1.2 and 1.25 respectively. The inner hollow part corresponds to a connected air gyroid with $u(x,y,z)=1.35$, shown in Fig. S2b. For hollow single gyroid consists of a-Si (150nm) / Al_2O_3 (40nm) /a-Si (150nm), the fill fraction is 0.12. The a-Si (150nm) / Al_2O_3 (40nm) /a-Si (150nm) layers have $u(x,y,z)$ values of 1.05, 1.2 and 1.25 respectively, and an inner air gyroid with $u(x,y,z)=1.37$. For $u(x,y,z)<1.41$, a solid gyroid structure is a connected network. The surface becomes disconnected at $u(x,y,z)=1.41$, as shown in Fig. S2b.