Characterisation of polymeric Rod-Connected Diamond Photonic Crystal templates at Near-Infrared range

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Abstract — We present a low-index polymeric three-dimensional photonic crystal, rod-connected diamond structure, created via direct laser writing, showing a partial photonic band gap at near-infrared wavelengths in both P and S polarization, measured by angular resolved Fourier image spectroscopy. We show initial tests of backfilling with high refractive index material aimed at achieving a full photonic bandgap in the near-infrared.

Rod connected diamond (RCD) [1], which is known to exhibit the largest full PBGs among all photonic crystal designs with the same index contrast [2], has been investigated but remains a significant challenge to create [3]. Here we use the direct laser writing method to fabricate a polymeric (n=1.52) RCD template and characterize its band structure via angular-resolved spectroscopy. We first calculate the RCD bandstructure using MPB software around wavelengths of interest using the results to optimize lattice parameters (Fig.1a). We then fabricated a structure and measured transmission (reflection) at normal incidence along the X' symmetry direction where we see a clear 20% dip (peak) in transmission (reflection) with center wavelength around 1500nm (Fig 1b). We then measure reflection spectra mapped as function of angle (Fig 1c) showing good agreement with the bandstructure features seen in Fig.1a.

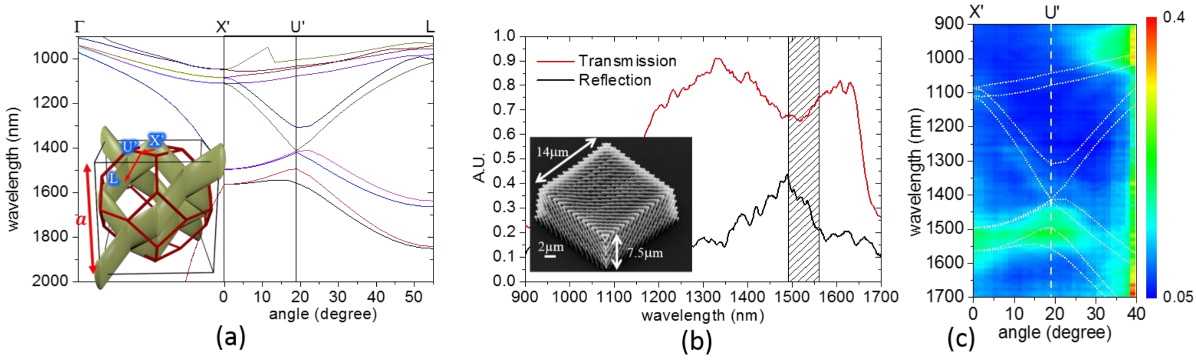

Figure 1 (a) MIT photonic-bands (MPB) calculation of RCD band structure at our measurement range, the insert defines the Brillouin zone of RCD and the principle directions (X', U', L), (b) transmission and reflection measurements at normal incidence, the insert show dimensions of structure, (c) measurement of reflection spectra against collection angle, incident with S polarized light.

Having successfully made polymeric RCD, we can then backfill this template with high refractive index (n=2.4) Chalcogenide material[4] to form high refractive index contrast (2.4:1) photonic crystal with full photonic bandgap. Our preliminary backfilled sample is shown in fig. 2a-c. By removing the polymer templates in a further process we can achieve high refractive index contrast. In the conference we will show our latest measurement results for these full photonic band gap RCD structures.

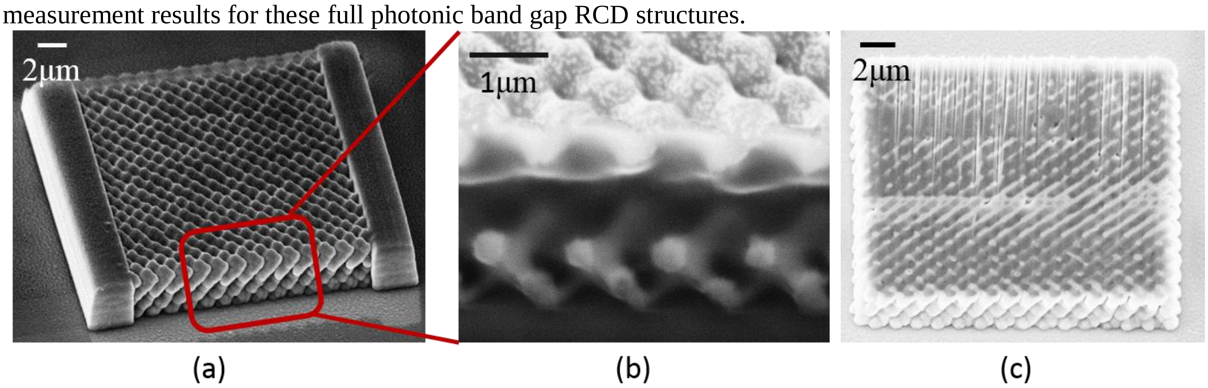

Figure 2 (a) overview of a backfilled RCD structure, (b) cross section and (c) top peel showing good back fill quality, bright parts are chalcogenide material and dark parts are polymer templates.

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