Metamaterials with a zero index of refraction offer uniform spatial phase and infinite wavelength [1, 2]. These extreme properties can be utilized for numerous integrated-optics applications including supercoupling [3] and simultaneous phase matching in nonlinear optics [4]. However, practical implementation of zero-index-based photonic devices necessitate integration with complementary metallic-oxide-semiconductor (CMOS) technologies. Zero-index metamaterials have been recently demonstrated in both out-of-plane [5] and on-chip configurations [6] by taking advantage of a photonic Dirac-cone dispersion at the center of the Brillouin zone [1]. Such designs offer matched impedance and low losses through simultaneously zero effective permittivity and permeability. However, these previously demonstrated configurations are inherently incompatible due to an out-of-plane configuration or metallic and high aspect-ratio structures, respectively.

We demonstrate a CMOS-compatible zero-index metamaterial consisting of a square array of air-holes in a 220-nm-thick silicon-on-insulator (SOI) wafer. This design is achieved through iteration of air-hole radius ($r$) and unit cell pitch ($a$). Using this air-hole in silicon configuration, we increase the proportion of silicon as compared to previous designs based on infinitely tall silicon pillars. This allows us to achieve a platform with low-aspect-ratio features and improved confinement of transverse electric (TE) polarized light.

To experimentally verify the refractive index, we measure refraction of TE-polarized light through a right triangular prism consisting of the metamaterial (Figure 1). The refracted beam exits the prism and is scattered at the edge of an adjacent semicircular SU-8 slab waveguide, where the angle of refraction, $\alpha$, is imaged by a near-infrared camera. The index of refraction $n_{\text{eff}}$ is then extracted using Snell’s Law:

$$n_{\text{SU8}}/n_{\text{eff}} = \sin 45^\circ / \sin \alpha$$

We observe a linear relation between refractive index and wavelength with the index transitioning from positive to negative index regimes and a zero index crossing of $\lambda = 1625$ nm (Figure 2).

With a relatively trivial monolithic fabrication and a capacity for integration with the expansive library of existing silicon photonic devices, this CMOS-compatible design will allow for implementation of several proposed zero-index devices and offers a powerful platform for exploring the future applications of zero-index materials.

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**Figure 1:** Fabricated zero-index metamaterial prism showing the incident and refracted ($\alpha$) beams.

**Figure 2:** a) Near-infrared microscope image of the prism at zero-index wavelength 1625 nm, showing the refracted beam. The black dotted lines indicate the position of the prism and input waveguide. b) Effective index of the metamaterial extracted from the measured (blue dots) and simulated (red line) angles of refraction ($\alpha$).

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