Subwavelength engineered silicon photonics

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By periodically patterning silicon with a pitch sufficiently small to suppress diffraction effects, subwavelength engineered structures can be realized with an arbitrary equivalent refractive index between those of silicon and air (i.e. ~ 3.5 to 1) [1-3]. The new degrees of freedom released by this subwavelength nanostructuration allow tailoring light propagation in silicon photonic circuits with unprecedented flexibility. This subwavelength metamaterial concept has been adopted by the industry for the implementation of high efficiency fiber-chip couplers [4], and has enabled the demonstration of several Si photonic components, some with best performance ever reported, including low loss waveguides and crossings [5,6], high efficiency surface grating couplers [7], or ultra-wideband beam splitters [8].

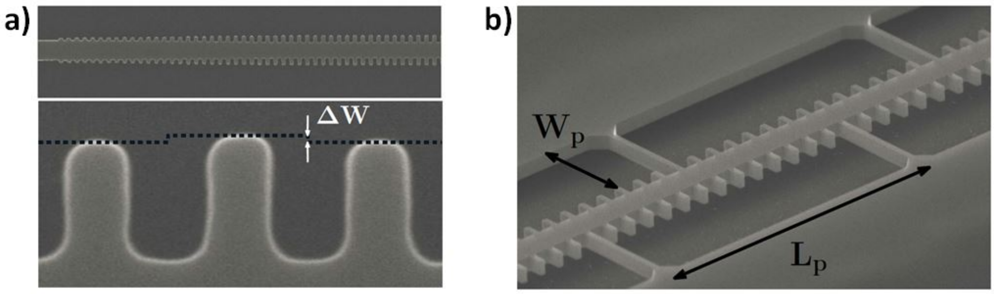

Figure 1. Scanning microscope images of a) subwavelength engineered Si narrowband Bragg rejection filter and b) subwavelength engineered Si membrane waveguide for hybrid near-infrared and mid-infrared operation.

Here, we present an overview of the principles and main applications of silicon subwavelength metamaterials and present our recent advances in the implementation of subwavelength engineered narrowband Bragg rejection filters (Fig. 1-a) and nanostructured Si membrane waveguides for hybrid operation in the near-infrared and the mid-infrared (Fig. 1-b).

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