# Compact integrated optical demultiplexers and spectrometers enabled by dispersion engineering in photonic crystals

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Photonic crystals offer unique dispersive properties that can be utilized for efficient implementation of new device ideas. The possibility to *design* the optical properties of photonic crystals by controlling the physical properties of the lattice through fabrication brings about the opportunity to obtain different dispersive properties in the same integrated optical material platform. In particular, we simultaneously engineer three dispersive properties of photonic crystals (i.e. negative diffraction, negative refraction, and the superprism effect) to realize compact integrated wavelength demultiplexers and spectrometers. [1],[2]

Here, we demonstrate a compact realization of planar photonic crystal wavelength demultiplexers in silicon-on-insulator wafers. By combining three unique dispersive properties of photonic crystals, we experimentally demonstrate a photonic crystal wavelength demultiplexer with practically acceptable performance and with at least two orders of magnitude smaller size compared to all previous demonstrations of the superprism effect. Using the same platform, we will also demonstrate integrated spectrometers showing the ability to locate spectral features with an accuracy of at least 10 pm in a 50 nm bandwidth. Implementation issues, including reflection loss at the interfaces and multimode operation in PCs, will be also addressed. Design strategies and appropriate matching stages will be presented to resolve these implementation issues.

[1] B. Momeni, J. Huang, M. Soltani, M. Askari, S. Mohammadi, M. Rakhshandehroo, and A. Adibi, *Optics Express* **14**, 2413 (2006).
[2] B. Momeni and A. Adibi, *Applied Optics*, **45**, 8466 (2006).