Recent progress in subwavelength grating metamaterial engineered silicon photonic devices

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Abstract (250 words)

Subwavelength grating (SWG) metamaterial waveguides have become essential components in integrated optics. Advancing the understanding of how they work is crucial to take advantage of the vast range of functionalities they offer. SWGs have been pivotal in the Silicon-on-Insulator platform, enabling the synthesis of metamaterials whose equivalent refractive indexes and dispersion can be easily engineered, while maintaining a single etch-step fabrication process. The main limitation of SWGs is the minimum feature size required for some devices, which is not always compatible with wafer-scale lithography techniques. This is the case for instance of apertures radiating highly collimated beams or ultra-narrow bandwidth Bragg filters, which require feature sizes as small as 10 nm, if implemented with waveguide sidewall gratings. To overcome this limitation, new metamaterial topologies are being proposed: the evanescent-coupled SWG and the bricked-SWG, the latter also providing control over anisotropy and thereby facilitating the development of polarization management devices.

In this talk we present our recent advances in SWG metamaterial engineering. We will show a 1D-optical phased array composed of 112 evanescent-coupled surface emitting antennas with a length of 1.5 mm and fed by a compact distributed Bragg deflector. The measurements demonstrate a wavelength-steerable collimated beam with a far-field angular divergence of $1.8^o \times 0.2^o$. Experimental results of a bricked SWG 2×2 MMI coupler are also shown, achieving polarization agnostic performance in the 1500nm to 1560nm wavelength range. Both devices were fabricated on a conventional 220-nm SOI platform using a single full-etch step process, with a minimum feature size of 80 nm, and thus compatible with immersion deep-UV lithography.

Summary for the program (100-200 words)

In this talk we present our recent advances in SWG metamaterial engineering. We will show a 1D-optical phased array composed of 112 evanescent-coupled surface emitting antennas with a length of 1.5 mm and fed by a compact distributed Bragg deflector. The measurements demonstrate a wavelength-steerable collimated beam with a far-field angular divergence of $1.8^o \times 0.2^o$. Experimental results of a bricked SWG 2×2 MMI coupler are also shown, achieving polarization agnostic performance in the 1500nm to 1560nm wavelength range. Both devices were fabricated on a standard 220-nm SOI platform using a single full-etch step process, with a minimum feature size of 80 nm, and thus compatible with immersion deep-UV lithography.

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