Traveling Wave Photon-Phonon Coupling in Silicon

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Abstract

In this paper, we demonstrate stimulated Brillouin scattering in silicon waveguides, for the first time, through a new class of hybrid photonic–phononic waveguides. We show that tailorable travelling-wave forward-stimulated Brillouin scattering is realized—with over 1,000 times larger nonlinearity than reported in previous systems—yielding strong Brillouin coupling to phonons from 1 to 18 GHz. Through nonlinear spectroscopy, we show that that radiation pressures, produced by sub-wavelength modal confinement, yield enhancement of Brillouin nonlinearity beyond those of material nonlinearity alone. In addition, such enhanced and wideband coherent phonon emission paves the way towards the hybridization of silicon photonics, microelectromechanical systems and CMOS signal-processing technologies on chip. Through this presentation, we give an overview of theoretical and experimental results described in [1–3]. Moreover, give an overview of our latest applications of Brillouin physics to coherent signal processing in RF-photonics.

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2. Rakich, P., Reinke, C., Camacho, R., Davids, P. & Wang, Z. Giant Enhancement of Stimulated Brillouin Scattering in the Subwavelength Limit. *Phys. Rev. X* **2,** 011008 (2012).

3. Shin, H. *et al.* Tailorable stimulated Brillouin scattering in nanoscale silicon waveguides. *Nat. Commun.* **4,** 1944 (2013).