FEL SCIENCE SEMINAR

October 15th, 2010, 10.00 a.m. – DESY Bldg. 49, Room 108

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Stimulated Raman Scattering in Silicon Photonics

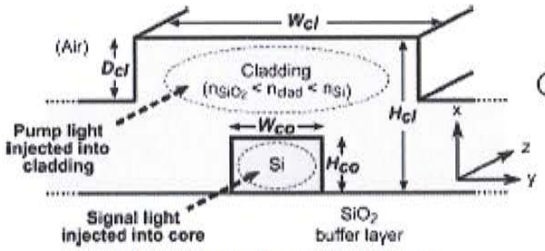
Stimulated Raman scattering is a nonlinear optical process in which signal light is amplified in the presence of shorter-wavelength pump light due to an interaction with the vibrational modes of the material. In optical fibers, this effect is already commercially exploited for realizing optical amplification in long-haul transmission systems. In silicon waveguides, on the other hand, Raman scattering has been demonstrated only very recently, in 2003 [1]. It was the first practical optical gain mechanism to be demonstrated for the rapidly evolving silicon-photonics platform [2].

This talk will summarize the principles, limitations and state of the art of Raman amplifiers and lasers in silicon. Modeling aspects and design rules for optimal Raman amplifiers will be discussed, and advanced designs will be introduced that can be used to mitigate the limiting effect of free-carrier absorption. Finally, we summarize recent results on and possible applications of the effect of Raman-induced nonreciprocity that is enabled by the presence of strong longitudinal mode-field components in highly confining silicon nanophotonic waveguides [3].

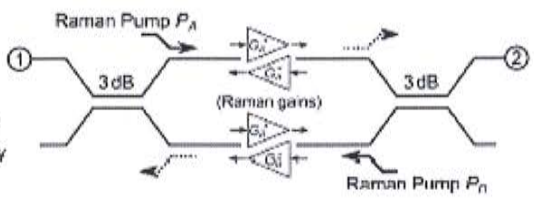
[1] R. Claps, D. Dimitropoulos, V. Raghunathan, Y. Han, B. Jalali, *"Observation of stimulated Raman amplification in silicon waveguides"*, Opt. Express 11(15), pp. 1731–1739 (2003)

[2] B. Jalali, *"Can silicon change photonics?"*, phys. stat. sol. (a) 205(2), pp. 213–224 (2008)

[3] M. Krause, H. Renner, E. Brinkmeyer, *"Strong enhancement of Raman-induced nonreciprocity in silicon waveguides by alignment with the crystallographic axes"*, Appl. Phys. Lett. 95, 261111 (2009)



Waveguide cross section of cladding-pumped Raman amplifier



Mach-Zehnder optical isolator based on Raman-induced nonreciprocity

Host: Robin Santra, CFEL Theory Group