RAMAN-BASED SILICON PHOTONICS: TECHNOLOGY AND APPLICATIONS

(KEYNOTE PRESENTATION)

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Photonic devices are essential building blocks of fiber optic networks that form the backbone of the internet. In addition, photonics is playing an increasing role in biomedical applications ranging from laser surgery to photo dynamic therapy. Silicon is the ultimate manufacturing technology and represents an unprecedented convergence of technological sophistication and economy of scale. Being able to tap into silicon's vast manufacturing base will reduce the cost of photonic devices, which in turn will accelerate penetration of photonics into mass markets.

Raman scattering is being pursued as a mean to bypass silicon's lack of direct bandgap and to create optical amplifiers and lasers. It is motivated by the fact that the stimulated Raman gain coefficient in silicon is $10^3 - 10^4$ times larger than that in fiber. The modal area in a silicon waveguide is roughly 100 times smaller than in fiber, resulting in a proportional increase in optical intensity. The combination makes it possible to realize chip-scale Raman devices that normally require kilometers of fiber to operate. The initial demonstrations of spontaneous Raman emission in 2002 was followed by the demonstration of stimulated Raman scattering and parametric Raman conversion in 2003. The last 12 months have witnessed accelerated progress highlighted by the demonstration of a pump laser in 2004 and a cw laser in 2005.

This paper will put in perspective recent progress including the demonstration of Raman amplification and lasing in GeSi waveguides.