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Hong Kong Chapter

SEMINAR

Center for Advanced Research in Photonics
&
Department of Electronic Engineering
The Chinese University of Hong Kong

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Energy harvesting in silicon photonic devices

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Abstract

Silicon is on the verge of becoming the material of choice for the photonics industry: the traditional stronghold of III–V semiconductors. The immense interest in silicon photonics has been primarily motivated by its compatibility with the mature complementary metal-oxide semiconductor (CMOS) technology, implicating the realization of integrated electronic and photonic chips on the same silicon-on-insulator (SOI) substrate. For silicon photonics to be truly compatible with very-large-scale-integrated (VLSI) chips, it must be compliant with one major requirement of the semiconductor industry: power efficiency. Power dissipation nowadays is the most pressing problem in the semiconductor industry, to the extent that it finally forced the microprocessor manufacturers to abandon higher clock speeds in favour of multi-core-processor architectures. The power dissipation of silicon photonic devices is therefore of paramount importance if they are to be compatible with CMOS VLSI technology.

One of the most exciting developments in silicon photonics has been the exploitation of third-order nonlinear optical properties. These effects have made a myriad of important functions possible in silicon: optical amplification and lasing, wavelength conversion. These are the central functions in multi-wavelength communications and signal processing. The common feature of such devices is the high optical intensity that is required to induce the nonlinear optical interactions. Concurrent with the useful optical nonlinearities are two-photon absorption and free carrier scattering, which are two related and harmful phenomena that render silicon lossy at high intensities.

This talk will describe a technique to explore the use of the two-photon photovoltaic effect as a means to circumvent the aforementioned power dissipation issue and the optical loss in silicon simultaneously. This useful phenomenon allows us to eliminate the nonlinear optical loss caused by free-carrier absorption, while to convert the optical power that is normally consumed by two-photon absorption into useable electrical energy which can be utilized to supply power to on-chip external circuitry. This energy harvesting approach is demonstrated in the context of Raman amplification, wavelength conversion and optical modulation.

About the Author：

Kevin Tsia received the B.E. and M.Phil. degrees in Electronic & Computer Engineering from the Hong Kong University of Science and Technology, Hong Kong, in 2003 and 2005, respectively. He is currently working toward the Ph.D. degree at the Electrical Engineering Department, at University of California, Los Angeles. His current research interests include active silicon photonic devices, particularly silicon Raman amplifiers and parametric wavelength converters with the two-photon photovoltaic effect. Mr. Tsia was the recipient of a Fellowship by the California Nanosystems Institute (CNSI) from 2005 to 2006.

***** All are welcome to attend *****

For further information contact Prof. Chester Shu at 2609 8258