Institute of Microelectronics
A*STAR

Technical Seminars

GUEST SPEAKERS

Dr Antti Saynatjoki
(Aalto University School of Science and Technology)

Mr Tapani Alasaarela
(Aalto University School of Science and Technology)

When: **8th June 2010, 2.00 p.m. to 4.00 p.m.**
Where: **Institute of Microelectronics, Singapore**
11 Science Park Road Singapore Science Park II Singapore 117685

Dr Antti Saynatjoki
Aalto University School of Science and Technology

Title: Nanostructures for Enhanced Functionality in Silicon Photonic Devices

Abstract
The mature processing technology, high refractive index and transparency at wavelengths above 1100 nm enable silicon-based integrated optical devices with sub-micron sized features. In a tightly confined optical field, non-linear effects can be invoked at moderate power levels, enabling all optical silicon devices such as a Raman laser, a wavelength converter, a signal regenerator and logic gates. Being the dominant material in microelectronics, silicon is also a very desired material for optoelectronic devices such as modulators and switches. However, silicon has its limitations in many applications. E.g., speed of silicon-based all-optical devices is limited by two-photon absorption and consequent free-carrier absorption, silicon is a poor light emitter, and has vanishing electro-optic and magneto-optic effects. There issues might be solved with hybrid integration of silicon with optimal materials for each application. However, the problem is how to confine light into the other material, because the optical field tends to be confined into silicon, which has a higher refractive index than almost any other material.

The mode can be confined into a nano-slot of low-index material on silicon. Using such a slot waveguide therefore provides means of efficiently integrate silicon-based waveguides with optimal materials for various purposes. However, the slot waveguide presents some technological challenges such as lithography and complete filling of nanoscale slots. Photonic crystal waveguides (PhCW's) have very different dispersion properties compared to conventional waveguides due to their periodic boundaries. In particular, PhCW's exhibit slow group velocity, which increases light-matter interaction and non-linearities, which can be utilised to realize more compact integrated optics devices. However, the slow modes also present some issues that must be solved, particularly group velocity dispersion, and coupling to conventional waveguides.

In this talk, the work on slot waveguides and slow light at Photonics group of Aalto University will be presented. The main focus is on slot waveguide designs for e.g. non-linear and magneto-optic functions, experimental results on slot waveguide filling with atomic layer deposited materials, dispersion engineering of slow-light photonic crystal waveguides, and couplers from strip waveguides to slot waveguides and slow-light waveguides.

Biography
Dr Antti Saynatjoki earned his D.Sc.(EE) degree at Helsinki University of Technology (TKK) - currently part of Aalto University - in 2008. His D.Sc. thesis "Photonic crystal waveguides for silicon integrated optics" was focused on design and characterisation of silicon-on-insulator based photonic crystal waveguides, particularly for slow-light devices. Now he is working as a post-doctoral researcher at Aalto University, conducting a Finnish Academy funded project "Novel devices for all-optical silicon chips" granted for years 2010-2012, and he is instructing 4 graduate students working on silicon and glass based nanophotonics. The main focus areas of the research are use of atomic deposited thin films in silicon photonics, magneto-optics on silicon, synthesis of glass-embedded silver nanoparticles using ion-exchange processes, and use of the nanoparticles in biosensing. He is an author in more than 20 refereed journal articles and more than 30 international conference publications in the fields of design, fabrication and characterisation of optical waveguides and photonic crystal waveguides, fabrication and characterisation of compound semiconductor X-ray detectors, and characterisation of semiconductor materials using synchrotron X-ray topography.

Mr Tapani Alasaarela
Aalto University School of Science and Technology

Title: Atomic Layer Deposition in Optical Applications

Abstract

Atomic layer deposition (ALD) was developed in 1970s to make better phosphors for thin film electroluminescent (TFEL) displays, but only in late 90s wider application development was started. ALD has been used to make optical thin film filters with microns of thickness. ALD is still seen more as an enabling technology, for applications needing high conformality, coating of difficult shapes or some special material features ALD can provide.

Optical ALD films are usually done using a batch ALD reactor as ALD can be scaled well to bigger batch sizes, and usually only large volumes make ALD economical. Some ALD processes like TiO_2 from $TiCl_4$ and water have thickness uniformity issues, but they can be solved using special processes. Crystal size limitation can be used with crystalline materials to keep the crystal size small for low scattering losses.

ALD can be used in many photonics applications. For example, amorphous TiO_2 can be used to reduce the feature size of slot waveguide structures or to make resonant waveguide gratings. ALD has been also demonstrated as a suitable way to do doping for specialty fiber performs.

Biography

Mr Tapani Alasaarela has a MSc in Optics and Photonics from Imperial College London and is now a preparing a doctoral thesis on using ALD in photonics applications at Aalto University and also working part-time for a ALD tool manufacturer Beneq.

Registration

Pre-registration is required. Closing date is 4th June 2010. To register, please log on:
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