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# Winter College on Optics:

# Advances in Nano-Optics and Plasmonics

## (6-17 February 2012 - SMR2328)

## LAMP Seminars
## session IV

## ABSTRACTS

## (Monday, 13 February 2012)

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**Preference: oral**

# Silicon structuring by etching with liquid chlorine and fluorine precursors using femtosecond laser pulses

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## Abstract

The aim of this study is to investigate the micro and submicrometer scale structuring of the silicon by liquid chlorine and fluorine precursors with a 200 fs laser pulses working both at fundamental (775 nm) and frequency doubled (387 nm) wavelengths. The silicon surface was irradiated at normal incidence, by immersing the Si (111) substrates in a glass container filled with liquid chlorine (CCl4) and fluorine (C2Cl3F3) precursors. We report that silicon surfaces develop array of spikes for single step irradiation proceses at 775 nm and equally at 387 nm. When irradiating the Si surface with a number of 400 pulses, 330 mJ/cm2 laser fluence at 775 nm wavelength, the average height of the formed Si spikes for the case of fluorine precursors is 4.2 μm, with a full width at half maximum of 890 nm. Chlorine precursors develop at the same wavelength irradiation Si spikes with 4 μm height and 2.3 μm full width at half maximum, for irradiation with a number of 700 pulses at 560 mJ/cm2 laser fluence. Well ordered areas of submicrometer spikes with an average height of about 500 nm and 300 nm wide have been created by irradiation at 387 nm by chlorine precursors, while the fluorine precursors fabricate spikes with an average height of 700 nm and about 200 nm wide. Atomic force microscopy and scanning electron microscopy of the surface show that the formation of the micro and sub-micro spikes involves a combination of capillary waves on the molten silicon surface and laser-induced etching of silicon, both at the 775 nm and 387 nm wavelength irradiation. The energy-dispersive x-rays measurements indicate the presence of chlorine and fluorine precursors on the structured surface. The fluorine precursors create more ordered area of Si spikes at both micro and sub-micro scale. The potential use of patterned Si substrates with gradient topography as model scaffolds for the systematic exploration of the role of 3D micro/nano morphology on cell adhesion and growth is envisaged.

**Preference: oral**

# Pulse – Oximetry and transillumination signal analysis as an optical technique for biomedical diagnosis

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## Abstract

Near infrared spectroscopy provides useful biological information after the radiation has penetrated through the tissue, within the therapeutic window (660 nm to 1050 nm). We describe a novel wavelength selection method for monitoring, based on a standard deviation map, it allows low noise sensitivity. It may be used with spectral transillumination, transmission, or reflection signals, including those corrupted by noise and unavoidable temporal effects. We apply it to the selection of two wavelengths for the case of pulse oximetry. We evaluate the oxygen saturation for different wavelengths in the spectral range from 650 to 1050 nm to determine useful wavelengths to study simultaneously several chromophores. Continuous monitoring using pulse oximetry provides the amount of oxygen in hemoglobin useful to early diagnosis and clinical decision-making.

From an analysis of transillumination signals at various wavelengths; we find that the signals present similar waveform. We proposed a method to study different effects presented in complex physiological signals based on Fourier Transform Analysis. We found that the normalized coefficients are quite steady; indicating that the shape of the attenuation functions has virtually the same shape at each wavelength. We proposed a transillumination waveform simulator to know the optical path-integrated when two or more incidances pass through a tissue. With the synthesized waveform we can simulate a series of effects such as the change of hemoglobin concentration, heart beat rate, sampling rate, digitizing resolution, numeric word size, add multiplicative or additive noise.

**Preference: oral**

# Investigation on refractive index profiles of copper ion exchange glass planar waveguides

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## Abstract

Glass planar optical waveguides were fabricated by copper ion-exchange technique. Refractive index (RI) profiles of waveguides were reconstructed by Inverse Wentzel–Kramers–Brillouin (IWKB) method. Cu+ and Cu2+ ion concentrations were calculated by solving diffusion equation, and the mechanism of RI changes was analyzed as well. The model between the RI and ion concentrations was proposed by taking both Cu+ and Cu2+ into account according to polarizability changes among Cu+, Cu2+ and Na+. The results show the contribution of Cu2+ can't be negligible, and the reason for the RI change is both Cu+ and Cu2+. With exchange time increasing, the redox process between Cu+ and Cu2+ will play an important role on RI profiles.

Preference: oral

# Multiple tumors treated by means of Photodynamic Therapy

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## Abstract

In this work the use of a chlorin e-6 based photosensitizer (Photolon®) to treat multiple Basal Cell Carcinomas is described. Local photodynamic therapy was performed in sixteen Venezuelan patients with a total of fifty seven lesions which were mostly superficial. Full tumor regressions with acceptable aesthetic results were reached in all lesions without any side-effects or complications during or after treatments. This work is the first report of photodynamic therapy using Photolon® in clinic practice in Venezuela.