Optical Nanospectroscopy for Tissue Imaging and Early Cancer Diagnostics

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Carcinomas are complex biochemical systems and in the past their diagnosis was based on morphological differences between malignant cells and their benign counterpart. Recently the paradigm has changed and great interest is focused now on the biochemical profile of tumours in view of the availability of new drugs that specifically target neoplastic cells. This new paradigm requires biochemical analysis of each tumour in order to establish the correct personalized oncological "target therapy". Understanding the mechanism of molecular alterations of a specific tumour is a critical issue to predict the response to personalized therapy. This is important not only for discrimination between healthy and pathological tissues, but also for pre-cancerous tissue state earlier detection and understanding.
The potential of infrared [1] and Raman spectroscopy [2] to characterise cancerous tissues has long been recognised and studies of various cancers by many groups have established that regions of malignant tissue can be easily identified on the basis of its optical spectrum. Early diagnosis of cancer requires an instrument providing specific chemical images at sub-cellular level and the development of diagnostic imaging. Infrared Scanning Near-field Optical Microscopy (IR-SNOM) and micro-Raman set-up meet these requirements provided that SNOM can been coupled with an appropriate infrared light source, that can be based on Free Electron Laser, femtosecond laser or quantum cascade laser.
We present IR-SNOM and micro-Raman in their spectroscopic mode, that is related to the local chemical composition and, thus, to the biological properties of the sample, for tissue imaging and early cancer diagnostics. Applications in the case of Oesophagous [3] and Cervical Cancer [4] as well as in the progression of Amyotrophic Lateral Sclerosis (ALS) [5] will be presented.

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