SNOM SPECTROSCOPY FOR TISSUE IMAGING AND CANCER DIAGNOSTICS

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We present a fully implemented Infrared (IR) Scanning Near-field Optical Microscopy (SNOM) in spectroscopic mode for tissue imaging and early cancer diagnostics. The SNOM has been coupled with an infrared light source, based on Free Electron Laser at the ALICE facility in Daresbury [1]. The potential of IR spectroscopy 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 IR spectrum. The oesophageal adenocarcinoma, the

Fig. 1. IR-SNOM image maps .

cancer with the fastest rise in incidence in the Western world, requires an instrument providing specific chemical images at sub-cellular level of oesophagus tissue.

Preliminary results of IR-SNOM on oesophageal adenocarcinoma have shown that the system can operate at nanometer resolution and has been able to distinguish between healthy and malignant tissues [2]. The optical fibre has been driven in particular areas of the oesophageal tissue and topographical and optical images have been collected simultaneously at different wavelengths. In particular, SNOM images were collected at wavelengths of 7.0 μm (no strong biomarker), 7.3 μm (protein/glycoprotein), and 8.05 μm (DNA). Figure 1 shows 40 μm x 40 μm optical SNOM images for two samples, labelled Cancer and Benign: the colour maps show the location of intense DNA (red), intense protein/glycoprotein (blue) and of strong overlap of DNA and protein/glycoprotein (orange). As clearly visible, Cancer sample shows a large spread of intense signal from DNA whereas Benign sample shows a lower overall density of DNA, which is more dispersed and exhibits more localised centres. This approach demonstrates the potential of the IR-SNOM spectroscopy for yielding an accurate diagnostic test for oesophageal and other types of cancers.
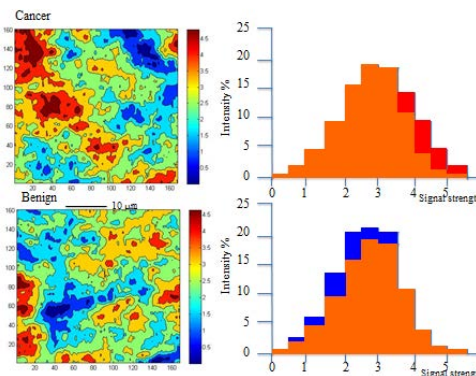
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References

[1] Cricenti A, Luce M, Tolk NH, Margaritondo G; Nanosci. Nanotechnol. Lett.; 3 (2011) 913;
[2] Smith AD, Siggel-King MRF, Holder GM, Cricenti A, Luce M, Harrison P, Martin DS, Surman M, Craig T, Barrett SD, Wolski A, Dunning DJ, Thompson NR, Saveliev Y, Pritchard DM, Varro A, Chattopadhyay S, Weightman P; Applied Physics Letters; 102 (2013) 053701.