Discrimination of cancer cell lines by reflection mode FTIR photo-acoustic spectroscopy

Tim J Harvey¹, Alex Henderson¹, Ehsan Gazi², Noel W Clarke², Mick Brown², Elsa Correia Faria¹, Richard D Snook¹ and Peter Gardner¹

¹School of Chemical Engineering and Analytical Science, Manchester Interdisciplinary Biocentre, University of Manchester, 131 Princess Street, Manchester, M1 7DN
²Genito-Urinary Cancer Research Group, Paterson Institute for Cancer Research, University of Manchester, Wilmslow Road, Manchester M20 4BX

Prostate cancer is one of the most common forms of cancer that affects men and early diagnosis of prostate cancer is a pre-requisite for a good prognosis. Initially diagnosis involves physical examination and measurement of the concentration of prostate specific antigen (PSA) in blood serum. However, PSA levels can be influenced by factors other than the presence of prostate cancer, which results in false positive results (only about 20% of patients with elevated PSA levels are discovered to have cancer). It would be advantageous therefore to be able to use infrared spectroscopy to identify circulating prostate cells found in blood or shed in urine prior to biopsy. Conventional infrared microscopy has been applied to study prostate cancer cell lines cultured onto infrared reflecting MirrIR plates followed by chemometric methods to separate the cell line based upon the infrared spectra. In these studies, however, because the wavelength of the IR used to probe the cells is similar in size to the cell nucleus, significant Mie scattering from the nucleus can occur resulting in distortion of line shapes and observable shifts in peak positions. The effect of IR scattering from the nucleus of the cells therefore could be influencing the discrimination between cell lines¹,². Photoacoustic spectrometry³, ⁴ is an alternative to IR spectroscopy and relies on the detection of acoustic waves in a closed cell, generated as a result of the absorption of modulated light. The amplitude of the PAS signal depends on the amount of absorbed energy that is converted to heat through non-radiative decay routes. Because a thermal signal is detected PAS can be used to analyse highly scattering materials, e.g. fine powders, crystalline and biological samples which warrants its potential use in in-vitro cancer studies where nuclei of the cell layer are likely to introduce adverse scattering effects in conventional IR spectroscopy. In this paper we show that four prostate cell lines cultured onto an infrared reflecting surface can be distinguished using PAS. The absence of scattering artefacts in the spectra suggests that differences in cell morphology (which would result in different degrees of scattering) are not responsible, in this experiment, for the discrimination of the cell lines.

References