Cancer Diagnostics by IR-Microspectroscopy of Human Biopsy Samples

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Thin dried tissue sections from human tissue biopsies (colon and bladder) have been analysed by MIR- transmission spectroscopy. Small areas (3 x 3 mm^2) of the sections were scanned using FT-IR microspectrometry. After spectroscopy, the sections were HE (Hematoxylin-Eosin)-stained and evaluated by a pathologist. In doing this the spectra were assigned to a set of tissue types (e.g. tumor, necrotic tissue, muscle tissue and connective tissue) according to the pathological assessment of the sections.
The tissue structure can be revealed by comparing each spectrum with average spectra gained from spectra of a single type of tissue. The correlation factor is used for comparison. Errors were estimated comparing the spectroscopic results with the pathological assessment.

For spectroscopic discrimination of tumor from normal tissue we investigated several methods of binary discriminant analysis. Linear and quadratic discriminant analysis (LDA,QDA) have been applied either directly to spectral data at specific wavenumbers or following transformation of spectra by principal component analysis (PCA). Each method was evaluated by cross validation.
For multivariate QDA deviations between spectroscopic prediction and pathological assessment could be reduced to 3 % approximately. This was achieved by optimization of the wavenumbers used for analysis. The distribution of errors shows that the main source of errors is the variance between biopsy samples from different patients.
For the samples used in our investigation discrimination of tumor vs. non tumor tissue was possible when only a small fraction of the spectroscopic data at two narrow wavelength regions is used. Therefore application of tuneable diode lasers is possible in principle.