# *Molecular Spectroscopy Methods for Kidney Cancer Diagnostics*

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According to the world cancer report in 2014; cancer is one of the leading causes for mortality worldwide [1]. Therefore, efforts are concentrated to detect cancer at early stage and to reduce cases of its not complete removal in operations - to enhance survival rates for cancer patients. Molecular methods like Raman, IR and fluorescence spectroscopy proved to be powerful tools for label free differentiation of cancerous and non-cancerous tissue [2]. However, the transfer of these results into the clinical applications is at very early stage. Reasons for that are not only technical troubles (not enough sensitivity, specificity and accuracy) ,but also too high costs for the instruments and special training needed for the operators. Hence, easy to handle cheap instruments are needed. Moreover, the specificity and sensitivity of the results should outperform conventionally used methods. This goal could be accomplished through the combination of methods and modification of expensive research systems to affordable sensors with friendly software using the adequate chemometric models.
Here, we present measurements on samples derived from patients with kidney cancer. For each patient tissue from healthy and cancerous parts of the kidney was analyzed. Combined molecular methods as Mid-Infrared, Diffuse Reflectance Near-Infrared, Raman and Fluorescence spectroscopy were used to analyze the same samples. MIR and Raman experiments were performed in the fingerprint region and in the range of the C-H stretching modes. For Raman, the focus onto the high wavenumber region is advantageous as there the fluorescence is less dominating and spectral information is sufficient to identify cancer [3]. That way, the same information can be retrieved with less equipment required. The same assumption was tested for MIR using polycrystalline IR- and chalcogenide IR-fibers. Additionally, NIR measurements were recorded using the spectral range from 900 to 1700nm, these results were compared to a newly developed LED sensor operating at four wavelengths. The approaches mentioned above should result in a simplification of the final instrument compared to the benchtop instruments. Finally, the data were analyzed and evaluated using multivariate analysis. Full separation of healthy and tumor tissues for 6 patients was obtained using Mid-IR or Raman spectroscopy. Other spectroscopic techniques have also exhibited some promising results that can be potentially used for tumor margin sensor development
For all presented techniques the penetration depth is limited. Therefore, an additional approach is pursued to analyze tissue lying beneath the skin. A MIR needle probe will enable in depth measurements for Minimally Invasive Surgery (MIS) and will provide higher specificity for the differentiation of tumors from healthy tissue.

References

[1] B. Stewart, C. Wild, World Cancer Report 2014, IARC, 2014
[2] Krafft et al., Raman and FTIR imaging of lung tissue, Vibr. Spectrosc., 46, 2008
[3] Puppels et al., Anal. Chem. 2005, 77(20), 6747-6752