Synchrotron-based microspectroscopy of human tissue samples at the Metrology Light Source (MLS)

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We focus on the sensitive biochemical and functional imaging of human tissue samples with the help of synchrotron-based FTIR-micospectrocopy. FTIR-microspectroscopy is an optical non-invasive technique and has proven to be a fast diagnostic readout tool for highly multiplexed analysis of various biomolecules, mainly in the biomedical field.
Depending on the experimental demands, micron-scale or rather sub-micron-scale resolution is the ultimate goal and synchrotron-based FTIR microspectroscopy could improve the resolution compared to conventional light sources, allowing high-resolution optical imaging of sub-structures and biomarkers introduced into the biosamples.
We performed systematic studies on the optical properties of human tissue samples under different preparation and conservation procedures in the spectral range from 1000 cm^{-1} to 3900 cm^{-1}. Our metrological approach included microspectroscopical studies in the MIR region under implementation of brilliant synchrotron radiation and internal light sources. Due to the wide frequency range of a brilliant synchrotron light source, the entire infrared spectrum in the range from far-IR to near-IR can be delivered for different experimental requirements.
FTIR-measurements were performed at the Metrology Light Source (MLS) of the PTB, an unique low-energy electron storage ring that provides the basis, as a versatile measurement and diagnostic tool, for numerous research applications, particularly in consideration of metrological aspects.[1,2] Furthermore, the MLS is the first electron storage ring optimized for generating coherent THz radiation.[3]
For a reliable clinical diagnosis considering the distinct localization of cancerous and healthy tissue areas, even in deep regions and especially at surgical intervention, we studied the interaction between electromagnetic waves and the sample matrices in the far-IR.
We will discuss the potentials concerning different experimental conditions of our synchrotron-based measurements on different biological samples with respect to their physicochemical properties. In our studies metrological aspects are taken into consideration, such as the sensitivity of the detection of tissue samples and tissue samples labeled with novel biomarkers and contrasting agents, as well as the reproducibility and spectral quality, i.e., signal-to-noise ratios of all datasets generated during synchrotron and globar light source excitation. Further experiments involve studies on the stability of synchrotron light spots of different sizes focussed at the sample/substrate interface during long-term radiation exposure.
Therefore, based on all performed and prospective measurements, we intend to deepen our experimental studies concerning the screening of novel biomedical assays and pursue novel synchrotron microspectroscopical applications, primarily in the biomedical field.

References

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