Does synchrotron infrared micro-spectroscopy favor some biomedical applications?

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Synchrotron infrared spectroscopy and micro-spectroscopy held a big promise in medical diagnosis. It is a powerful methology to identify metabolic changes occurring at single cell level.

The brightness advantage, combined with a high beam stability (especially on recent third generation synchrotron), has resulted in fast data recording at high lateral resolution, with very good spectral quality(S/N). Several biomedical applications have been carried out at the SMIS beamline at SOLEIL during recent years.

Urinary stone disease, constitutes a major health problem and is affecting an increasing number of people. Calcium oxalate, calcium phosphate, uric acid, ammonium hydrogen urate and magnesium ammonium phosphate are the main components of stones. Very small crystals in the kidney biopsy sample, of 2,8-dihydroxyadenine (2,8-DHA) were identified , and this has direct relevant therapeutic implications. IR synchrotron microscopy is actually routinely used by doctors from Hospital for a rapid screening of kidney sections. This results in a direct implication in the patient therapy and recovery.

The potential changes occurring in hematopoietic cells expressing BCR-ABl and BCR-ABL carrying T3151 mutation, conferring resistance to most tyrosine kinase inhibitors currently used has been evaluated using IR micro-spectroscopy. The use of the synchrotron is fully justified due to the small dimension of human leukemia cells.

Stem cells research is a very important research topic nowadays. Several studies have shown that IR microscopy can determine the differentiation state of the stem cells. But more importantly, we have been able to show that synchrotron IR microscopy can assess unambiguously the reprogrammation of stem cells, which is more difficult otherwise.

Liver steatosis is a severe disease that can lead to hepatosteatosis, cirrhosis and cancer. The precise determination of the steatosis content during the liver transplant is crucial with recommendation to select livers exhibiting no more than 20% steatosis. This drastic recommendation contrasts with the incapacity of usual histological methods to rigorously provide an objective and non-biased assessment of steatosis. Synchrotron infrared microspectroscopy has helped determining the presence of micro vesicle with lipids content that can be directly related to the lipidomic HPLC tests. The database established with the synchrotron source is actually used to condition an IR thermal source based microscope, to be set up in hospital for direct diagnostic during liver transplant.