FTIR Imaging and Spectroscopy with Six Decades Spatial Dynamic Range

Christophe Sandt,[1] Stéphane Lefrançois,[1] Alexandre Dazzi,[2] Hans A. Bechtel,[3] Honghua Yang,[4] Craig Prater,[4] Ferenc Borondics[1,*]

[1] *Synchrotron Soleil, BP48, L'Orme des Merisiers, Gif sur Yvette Cédex, 91192, France*
[2] *Université Paris-Sud, Laboratoire de Chimie Physique, Orsay, 91405, France*
[3] *Advanced Light Source Division, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720, USA*
[4] *Anasys Instruments, 325 Chapala St, Santa Barbara, CA 93101 USA*
[5] *Institut d'Astrophysique Spatiale, CNRS, UMR-8617, Campus de l'Université Paris-Sud, Orsay, 91405, France*
[6] *Agilent Technologies, 679 Springvale Rd, Mulgrave, Melbourne, VIC. 3170, Australia*
** ferenc.borondics@synchrotron-soleil.fr*

Abstract: The SMIS beamline allows a multitechnique and multiscale approach to FTIR studies. The newest developments and capabilities, with special focus on the technical details and preliminary results on nanoscale measurements the fastest growing field in synchrotron FTIR instrumentation will be reviewed.

FTIR spectroscopy and microscopy are well-established methods in the synchrotron world and beamlines exist at more than thirty facilities around the planet. Although the intensity of IR radiation lags behind that of thermal sources, the size of the electron beam and small extraction angles of synchrotron (SR) beamlines provide 100-1000 times higher brightness when focused. In practice this allows diffraction limited raster mapping and spectromicroscopy. Experiments exploiting diffraction limited capabilities at the SMIS beamline range from biology to high-pressure physics. Some of the recent results will be highlighted from a selection of fields demonstrating this capability.

FTIR imaging is routinely provided by the platforms of all major FTIR microscope manufacturers. The synchrotron advantage can also be realized in the field of imaging by exploiting the beam characteristics of the source. By accumulating spatially oversampled datasets it is possible to break the far-field diffraction limit via the application of point spread function deconvolution. After the construction of the first synchrotron endstations for full-field imaging the next step was to exploit the high brightness of the synchrotron source in realizing tomography measurements. In the last section of the presentation the current developments in the field of 2D and 3D imaging at SMIS will be also highlighted.

Scanning probe microscopy combined with infrared light exploiting near field physics had been demonstrated as a new paradigm in infrared spectromicroscopy and implemented at several synchrotron beamlines. The two currently existing methods, light scattering based scanning probe near-field optical microscopy (sSNOM) and photothermal spectroscopy and imaging using AFM detection (AFM-IR) are available through several commercial instruments. Currently, we are in the process of adapting a combined sSNOM and AFM-IR microscope to the synchrotron beam. At the time of submitting this abstract we have already demonstrated the full sSNOM capability, which will be included in the presentation. Technical details about the challenges of the implementation will be also discussed.