Spectroscopy

Infrared Spectroscopy

B22 Technical Information

# B22 - Multimode IR Imaging and Microspectroscopy

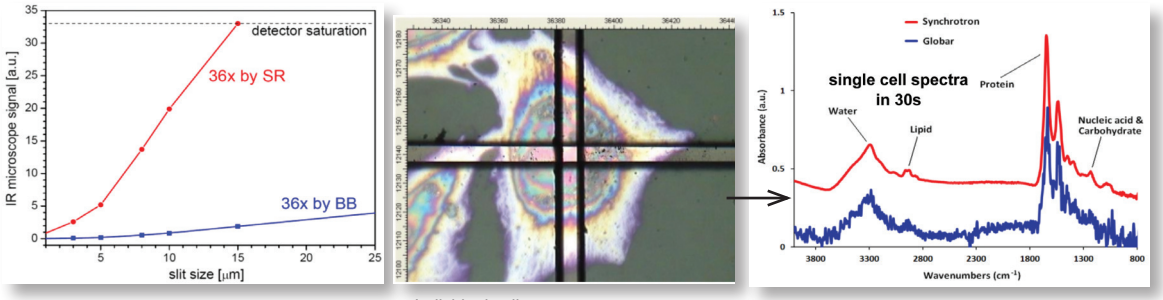
Infrared (IR) microspectroscopy is a quantitative analytical and non-destructive technique which has undergone a renaissance using synchrotron radiation (SR) as a highly brilliant and broadband source.

Fourier Transform IR (FTIR) interferometry has proven extremely effective in research for revealing vibrational modes of molecular components at the microscopic scale. The high photon flux density benefit of a synchrotron provides FTIR microspectroscopy with a signal-to-noise ratio unreachable by other broadband sources at diffraction limited spatial resolution (as fine as 3 to 10 µm in the mid-IR range).

The extreme Far-IR (THz) range is accessible for spectroscopy experiments. In special user mode, the coherent SR THz photon flux can be >1000 times more intense than conventional sources.

## Benefits of synchrotron IR:

- brightness improves spatial resolution and signal-to-noise ratio;
- an intrinsically polarised source;
- pulsed source of the electrons enabling time resolved studies.




Individual cell spectra

## Beamline Specification

| | |
|---|---|
| Spectral range [$cm^{-1}$] | 10000 – 5 |
| Spectral resolution [$cm^{-1}$] | > 0.07 |
| IR flux density relative to globar | above 40 times at 8x8 $\mu m^2$ in the mid IR range |
| Beam size at the sample [µm] | 3 to 15 fwhm by slits |
| Beam stability at the sample [µm] | +/- 0.1 at the sample |
| Signal to Noise at the sample | 0.05% rms n/s on 100% transmission line * |
| Sample Environment | Microscope T controlled Linkam cell from 77 to 600 K |
| | Compression cell including diamond windows |
| | Liquid static/flow cell (spacer from 6 mm) |
| Objectives/Condensers | 15x, 36x, 74x objective and condensers<br>Grazing angle objective for thin film measurements<br>Si and Ge crystal micro-ATR |
| Detectors | 2 MCT single detectors: 100x100 $\mu m^2$ and 50x50 $\mu m^2$<br>2 Focal Plane Array detectors 64x64: pixel size 40x40 $\mu m^2$<br>IR Bolometer at 4.2 K and 1.6 K |

* Via 74x objective above 8x8 $\mu m^2$ aperture co-adding 128 scans at 4 $cm^{-1}$ resolution in the range 2400 to 2800 $cm^{-1}$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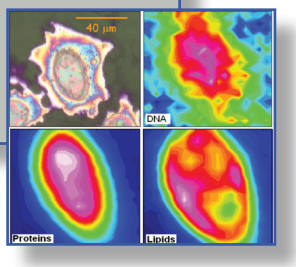
B22 Applications

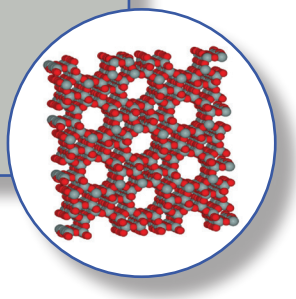
## Biomedicine

- Identification of pre-malignant changes in cancer cells from cervical smears;
- Understanding the effect of chemotherapy at the single-cell level;
- Discrimination of creatine levels inside brain tissue plaques in Alzheimer's disease.



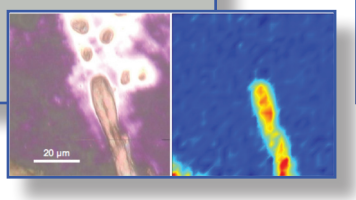

## Surface Science

- Time-resolved mapping of reaction progress in zeolites. Intermediates, diffusion and template decomposition;
- Synthesis, adsorption states and reaction dynamics in heterogenous industrial catalysts e.g. for methanol production and hydrotreating reactions;
- Study of alloy electrocatalyst surfaces of metal/solution interfaces.



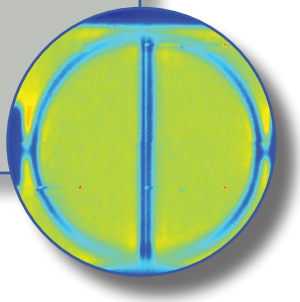
## Environmental

- Study of the effect of metals on bacterial cells in aqueous environments;
- Elucidation of COO-, $PO_3^{4-}$, $SO_4^{2-}$, $NH^+$, $OH^-$ vibrational properties and complexing functionalities on bacterial surfaces;
- Imaging of growth and characterisation of microbial community diversity and mineral phases within biofilms.




## Polymer Science

- Study of reorientations and conformational changes of polymer films;
- Probing UV photochemical degradation processes in acrylic polymer films;
- Mapping additive diffusion in single and multilayered polymers.



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