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Latest developments and capabilities at the Infrared Microspectroscopy Beamline

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The Infrared Microspectroscopy (IRM) beamline has been in operation for user experiments since 2007 and continues to provide access to cutting edge Fourier transform infrared (FTIR) microscope instrumentation with a bright, diffraction limited infrared beam for the analysis of diverse materials form single cells to cultural artefacts, and composite materials to food products. This presentation will provide an update on the current status and capabilities of the IRM beamline, illustrated with relevant case studies.

Operation of the microscope in transmission mode provides a lateral resolution of between 4 m and 10 m, depending on wavelength, and is suitable for the analysis of thin films, single biological cells and microtomed thin sections of materials from biological tissues to polymer composites. The IRM beamline is equipped with a range of sample chambers for use in transmission mode, including a diamond compression cell for the flattening of materials, a Linkam heated stage for analysis at temperatures between -195℃ and 600℃, and a set of custom liquid chambers for the analysis of live biological samples.

Reflection and grazing incidence capabilities enable the analysis of certain materials that either have a polished surface, or are presented as a thin film coating on the surface of a reflective metal substrate.

Enhanced lateral resolution, and the ability to map materials that are otherwise not suited to transmission IR microanalysis, are achieved by the Attenuated Total Reflection (ATR) method. The ATR approach has been developed as a key capability of the IRM beamline, and a separate presentation on this will be given at this meeting.

The standard operating spectral range for the IRM microscope is from 4000 cm-1 to 750 cm-1, using a high sensitivity narrow band detector. This range can be extended on request using a wide band detector with a lower limit of around 500 cm-1, but with an overall loss of sensitivity across the full mid-IR range. A further extension of the range is possible through the use of a far-IR Si:B photodetector, or a Bolometer detector, with a lower limit of 250 cm-1 set by the IRM beamline infrared window. A focal plane array detector can be made available for certain experiments requiring snapshot images of small regions of around 30 30 m.

Rapid scan IR measurements at a microscopic scale are possible on the IRM beamline, with the ability to collect 65 spectra per second at 16 cm-1 spectral resolution.

Future developments at the IRM beamline include the use of higher numerical aperture optics for improved beam collection in the reflection analysis of materials, a liquid ATR flow cell for the study of live biological samples at high spatial resolution, full piezo control of all adjustable mirrors and pinholes within the IR microscope, and improved capabilities for mail-in experiments.

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