# Main advantages of Synchrotron Infrared Microscopy: Present and Future


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Facilities for IR synchrotron radiation can be found throughout the world, serving to produce light for the scientific community. Infrared microscopy beamlines are operational or under construction in several facilities[1]. The brightness advantage (about two orders of magnitude) of the synchrotron source compared to a classical thermal source has attracted several microscopists from various communities: Geology, Soft Matter, Forensic, Biology and Biomedical.

The synchrotron source has to be accurately known and characterize in order to collect efficiently, then propagate the beam to the infrared spectrometer. Simulation is becoming a useful means for efficiently coupling the emitted photons with the spectrometer and the microscope, in order to achieve the best performances. This will be illustrated in this presentation.

Besides spectroscopy, chemical imaging is one of the main issues of microscopists. Chemical imaging requires high spatial resolution, high spectral quality, fast recording time, and, importantly, contrast fidelity! This contrast fidelity suggests that no artefact is introduced into the chemical image. I will show that conventional microscopes, equipped with focal plane array detectors, are not keeping the contrast fidelity when the spatial resolution is approaching the diffraction limit!

Several examples of the actual performances of synchrotron infrared spectroscopy will be presented: inclusions in geology, single cells and human tissues analysis.

However, the usefulness of the synchrotron beam, its uniqueness, may appear to be challenged by the recent development in detector technology (one dimensional, and two dimensional array detectors are now available) , which has led to much higher spectral quality and much faster recording time with thermal source. The basic reasons of such improvements will be presented.

In this talk, I will show why the synchrotron source is the unique source for analysis at the diffraction limit. Future directions will be suggested. Expectations of an improvement of a factor of 2 to 3 in spatial resolution can be made by considering the Point Spread Function method of a large pixelated detector[2].

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[1] Active IR microspectroscopy beamlines are found at NSLS, Brookhaven, ALS, Berkeley and SRC, Stoughton (USA); UVSOR, Okasaki and SPring8, Nishi-Harima (Japan); NSRRC, Hsinchu (Taiwan). In Europe, IR activities continue at the SRS, Daresbury (UK); ESRF, Grenoble (France); MAXLAB, Lund (Sweden); and at Daφne, Frascati (Italy); ANKA, Karlsruhe (Germany); BESSY II, Berlin (Germany). Other facilities that are planning IR microspectroscopy programs include Diamond, Rutherford Lab (UK); SOLEIL, Paris (France); DELTA, Dortmund (Germany); ELETTRA, Trieste (Italy); SLS, Villigen (Switzerland); Duke-FEL, Durham (USA); CLS, Saskatoon (Canada); CAMD, Baton Rouge, (USA); SURF-3, Gaithersburg (USA); Australian Synchrotron, Melbourne (Australia); and NSRL, Hefei (China).

[2] G.L.Carr, O. Chubar and P. Dumas « **Multichannel Detection with a Synchrotron Light Source: Design and Potential"**to appear in SPECTROCHEMICAL ANALYSIS USING MULTICHANNEL INFRARED DETECTORS, Analytical Chemistry Series