SYNCHROTRON INFRARED MICROSPECTROSCOPY: RECENT DEVELOPMENTS AND PERSPECTIVES FOR ALBA.

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Modern synchrotrons provide a low divergence, diffraction-limited infrared point source with a very high photon flux per source area and solid angle. In the mid infrared region ($\lambda < 25$ μm) the power per unit wavelength is lower than that of a conventional IR blackbody source; although the synchrotron beam can provide a factor of around 1000 improvement in brightness [1]. Both flux and brightness largely exceed those of a thermal source in the far-IR(THz) range. In microscopy, unprecendented SNR is achieved at a spatial resolution of 5 μm.. This ideal IR source can be perfectly coupled to a microscope since all of the flux can be efficiently concentrated in a very small area, between 5 μm – 10 μm.

Since the development of the first synchrotron IR microspectroscopy (SIRMS) beamline at Brookhaven National Laboratory [2] the technique has rapidly expanded due to its wide applicability, and around 20 SIRMS beamlines are currently operating or projected worldwide. This powerful, cost effective analytical technique has already had a significant impact in biology and biomedicine, polymeric materials, terrestrial and extraterrestrial geology, surface science and electrochemistry, industrial research and forensics. Some examples will be presented.

Recent developments in SIRMS will be illustrated in terms of the key characteristics of a synchrotron IR that make it much more effective than a conventional globar source. In particular we will discuss the nature of the synchrotron IR beam, determined by the cross-section of the electron beam and the angle into which the radiation is emitted, as a function of the machine parameters of the storage ring and the configuration of the transfer optics to the IR experimental station. Taking several operating IR beamlines as examples, the perspectives for an IR microspectroscopy beamline at ALBA will be commented.

In this respect, in addition to the spatial mapping of microscopic samples, several other advantages provided by a synchrotron source may be explored some of which will be described, such as the polarization properties as a function of the type of radiation extracted, the exploitation of the nature of the electron bunches for the study of time-dependent phenomena, and the application of highly stable focal plane array detectors for synchrotron IR imaging spectroscopy, and the implications these may have for the development of a highly versatile microspectroscopy beamline.

References

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