Biological Applications Of Synchrotron IR Spectromicroscopy

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Synchrotron radiation-based Fourier transform infrared (SR-FTIR) spectromicroscopy is a newly emerging bioanalytical and imaging tool. This unique technique provides mid-infrared (IR) spectra, hence chemical information, with high signal-to-noise at spatial resolutions as fine as 3 to 10 microns. Thus it enables researchers to locate, identify, and track specific chemical events within an individual living mammalian cell. Mid-IR photons are too low in energy (0.05 - 0.5 eV) to either break bonds or to cause ionization. In this review, I show that the synchrotron IR beam has no detectable effects on the short- and long-term viability, reproductive integrity, cell-cycle progression, and mitochondrial metabolism in living human cells, and produces only minimal sample heating (< 0.5°C). I will then present several examples demonstrating applications of SR-FTIR spectromicroscopy in biological research. These will include monitoring living cells progressing through the cell cycle, including death, cells reacting to dilute concentrations of toxins, and monitoring bacterial as they detoxify pollutants. I will conclude with some of the future directions for synchrotron infrared research.