First Synchrotron-Based PhotoThermal InfraRed NanoSpectroscopy at Diamond

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InfraRed spectra were obtained at sub-wavelength scale for the first time via synchrotron illumination and photo-thermal method [1]. At the MIRIAM beamline of the UK's national synchrotron facility Diamond Light Source, an atomic force microscope (AFM) is coupled to an infrared (IR) microbeam in order to exploit both sub-micron resolution via an AFM tip, and molecular IR spectroscopy via broadband synchrotron illumination. A dedicated IR microscope was built to allow for optimal illumination both from top and bottom of the sample via IR objectives. To beat the diffraction limit and achieve a detectable signal, the resonance enhanced photo-thermal approach is used: i.e. the IR excitation is modulated via a fast optical chopper and tuned to the AFM cantilever resonance frequency. The locked in signal is used by a Fourier Transform IR (FTIR) interferometer that measures the absorption spectrum. The relative complexity of the setup is counterbalanced by the advantages of photothermal IR nanoprobe, namely to provide a direct and linear absorption spectrum of the specimen, plus bulk sensitivity.

First results on photo-thermal IR nano-spectroscopy and IR nano-imaging [2] obtained at MIRIAM beamline are shown with particular focus on polymer and organic materials, including examples of biomedical specimens.

References

[1] Donaldson et al., Optics Express 24(3), 1852-1864 (2016).
[2] Cinque et al. Synchrotron Radiation News, 29(4) 37-39 (2016).