TIME (DO NOT FILL IN)

IRENI: Infrared Environmental Imaging at the Synchrotron Radiation Center

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A new mid-infrared beamline (IRENI) extracting 320 hor. x 25 vert. $mrads^2$ to homogeneously illuminate a commercial IR microscope equipped with an infrared Focal Plane Array (FPA) detector has recently been commissioned. The swath of radiation from the SRC is extracted as 12 beams and recombined into a 3 x 4 bundle of beams that is refocused onto a sample plane of an infrared microscope illuminating 40 x 60 $micron^2$ sample area. This new facility provides the opportunity to obtain chemical images with diffraction-limited (or better) resolution in minutes. The detailed design and construction of this facility will be presented.

IRENI combines a bright IR synchrotron source to an IR microscope with a multi-element detector to do wide field imaging as opposed to the common confocal geometry with raster scanning with most beamlines. The FPA is a detector constructed of an array of individual detecting elements at the detector plane. Importantly, the signals from the detectors are read in parallel, affording the ability to collect an array of data very quickly (less than 1 minute to collect 4 cm^{-1} resolution) of high quality, diffraction-limited (better than the wavelength of light) raw image. For comparison, if one measures an area of 64 x 64 pixels with the confocal method, at 30 secs of measuring time to collect a spectrum per pixel, it would take 1.4 days to collect 4096 pixels of data. In contrast, this entire map can be collected in less than 15 minutes with the present technology of 64 x 64 pixel focal plane array (FPA) detectors.

The optical arrangement of the microscope at IRENI is based on a Bruker Optics Hyperion Microscope that is equipped with a 20x Schwarzschild condenser (modified from a GAO) and 74x Schwarzschild objective achieving effective geometric pixel sizes of 0.54 x 0.54 mm^2. This effective pixel size is approximately l/5 for even the shortest wavelength of 2 µm, providing adequate information for point spread function (PSF) deconvolutions of the chemical images to obtain high fidelity images and high quality spectra for each pixel.

Signal and Signal/Noise characteristics of the beamline will be discussed, including examples in both reflection and transmission geometries. The performance characteristics of a feedback system based on the Advanced Light Source system that has been implemented will be discussed.

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