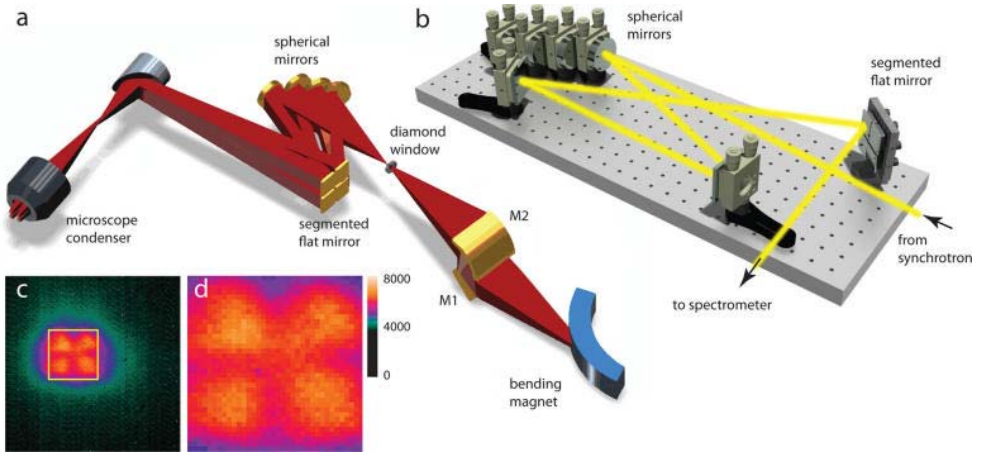
Making High-res Movies with an Infrared Microscope

Scientific Achievement

Designed and built configuration of simple optics usable for illuminating a multipixel array detector on most synchrotron infrared beamlines to increase resolution and speed of data acquisition beyond conventional instruments

Significance and Impact

Greater resolution and faster data acquisition open new avenues for infrared imaging, allowing researchers to record "movies" of, for example, chemical transformations where only static "snapshots" were once possible



(a) Schematic of the multibeam synchrotron infrared imaging beamline. The bending magnet radiation is extracted and the source is reimaged by means of the elliptical M2 mirror. The diverging fan of light is split into four nearly collimated beamlets, which are subsequently recombined at the sample position. (b) Light path in the optical matching box. Only one beamlet is shown for clarity. Two folding mirrors provide additional control over the beam alignment. (c) Illuminated area of the 128 X 128 pixel focal plane array detector and (d) the enlarged FPA area of 36 X 36 pixels, showing nearly uniform illumination.

Research Details

- Coupling the bright synchrotron source to a multipixel array detector enables high-magnification imaging with a 0.5-micron pixel resolution. With oversampling and image deconvolution, a spatial resolution beyond the diffraction limit was achieved and used to identify individual tracks of grey matter in spinal-cord tissue.
- Taking full images with an array detector allows for data acquisition that is thousands of times faster than point scanning, allowing researchers to generate time-lapsed images that demonstrated degradation of micrometer-sized polymer beads under ultraviolet radiation.

E Stavitski, RJ Smith, MW Bourassa, AS Acerbo, GL Carr, and LM Miller, *Analytical Chemistry*, **85**, 3599-3605 (2013)

Work was performed at Brookhaven National Laboratory