

Recent Advances in IR Microspectroscopy at SRC: New Multi-Element Detector & Flow Cell Design

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Part 1: Examining kinetics of living cells (phytoplankton), fungi and bacteria-mineral interactions requires the ability to image sufficiently large sample areas encompassing even large whole cells quickly on biological time scales. The brilliance of the synchrotron is critical to

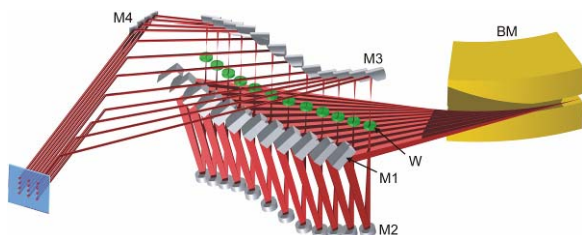
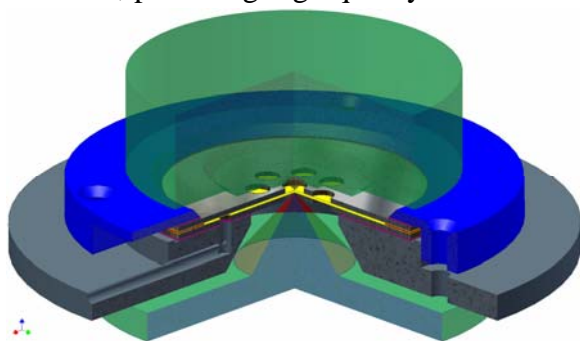


Figure 1: Schematic (not to scale) of the new IRMSI-MED beamline at the SRC. For clarity, only 4 out of the 12 M4 mirrors are shown.

provide sufficient flux density to obtain diffraction limited images on such short time scales (in under a minute). The University of Wisconsin–Milwaukee is designing and installing a mid-infrared (IR) beamline for Microspectroscopy Imaging (IRMSI-MED) that will extract 320 hor. \times 25 vert. mrad² from a dedicated bending magnet (BM) at the Synchrotron Radiation Center (see Fig. 1). Multiple overlapping beams are used to homogeneously illuminate the sample area, imaged onto a multi-element detector (MED). Proof of principle experiments using an existing beamline at the NSLS have been performed by Carr *et al.* [1]. First microspectroscopic maps have been successfully obtained on a beamline with one beam in under a minute.

Part 2: A new flow cell has been designed to measure living cells under controlled aqueous environs, providing high quality data for the entire mid-IR spectral range. The flow cell (cf. Fig.



2) features a slim profile which accommodates small working distances, down to 0.6 mm above the cell and 6 mm below the cell. This allows measurements at high magnification for both transmission and reflection geometries, in the IR (e.g., 32x, 74x) and visible (up to 100x). We have selected sub-micron thick diamond windows due to their excellent transmission properties over the entire IR and visible spectral ranges, and to minimize fringing effects. A peristaltic pump can

be coupled to the flow cell to provide exchange of medium on demand.

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References:

[1] G.L. Carr, L. Miller, R. Smith, R. Jackson and T. Tague Jr., private communication.