Infrared Environmental Imaging (IRENI): First Light

M. J. Nasse[1,2], R. Reininger[2,3], S. Janowski[2], T. Kubala[2], E. Mattson[1], and C. Hirschmugl[1]
[1] Dept. of Physics, UW-Milwaukee, Milwaukee, WI 53211
[2] SRC, UW-Madison, 3731 Schneider Dr., Stoughton, WI 53589
[3] Scientific Answers & Solutions, 5708 Restal St., Madison, WI 53711

Biochemical kinetics of living biological cells, such as phytoplankton, fungi, bacteria etc., is a key problem of physiology and ecology. Synchrotron-based infrared (IR) microspectroscopy is an ideal tool in these research fields since it can provide spatially resolved chemical information on a micrometer scale without damaging the specimen. For a long time its biggest drawback has been extended acquisition times for IR maps of several hours due to the conventional confocal setup, encumbering the access to kinetic processes on the minute or second time scale.

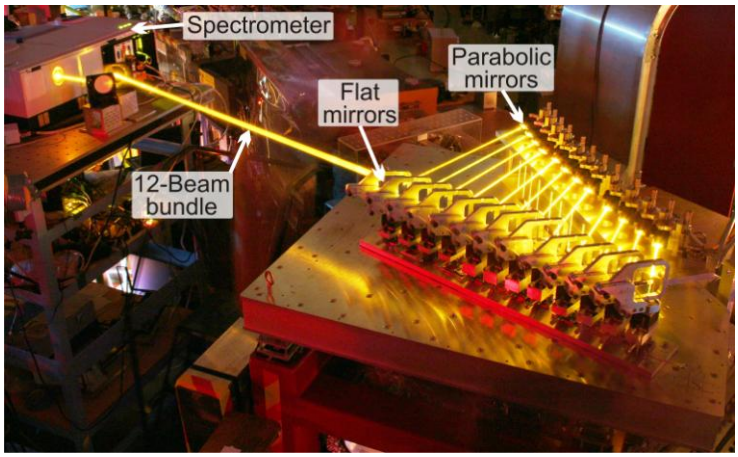

Figure 1: Long-time exposure showing the 12 synchrotron beams being collimated by a set of 12 parabolic mirrors and rearranged in a 3 x 4 matrix by 12 small flat mirrors. The resulting bundle of 12 beams is then steered into the spectrometer.

The University of Wisconsin–Milwaukee, together with SRC, has designed, installed and is currently commissioning a novel mid-IR beamline that will allow to acquire full, diffraction-limited mid-IR microspectroscopic maps (sample area: 40 x 60 μm^2) in under a minute [1]. The beamline extracts 320 hor. x 25 vert. $mrad^2$ from a dedicated bending magnet. This fan of light is separated into 12 beams and rearranged into a 3 x 4 beam bundle (see Fig. 1) with the help of a total of 48 mirrors. The bundle is then sent into a commercial IR spectrometer and microscope. The latter is equipped with a liquid nitrogen cooled Focal Plane Array (FPA – a multi-element IR detector) with 128 x 128 pixels onto which the sample is imaged.

While commissioning and fine-tuning of the mirror alignment of the new beamline is still ongoing, we celebrated first light earlier in August 2008. Figure 2 shows the 12 beams (here in focus) on the FPA (no sample). Once the alignment is finished the beams will be slightly defocused in order to achieve a more homogenous sample illumination.

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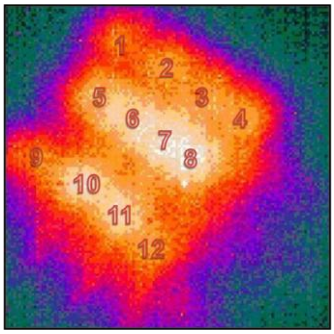

Figure 2: IRENI's first light: Focal Plane image showing the 12 infrared beam spots.

References:

[1] M.J. Nasse, R. Reininger, T. Kubala, S. Janowski, and C. Hirschmugl, NIM A **582**, 107 (2007).