

Resolution Studies of Schwarzschild-type Infrared Microscope Objectives

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A scanning infrared microspectrometer produces images based on the distinctive molecular absorption features of chemicals in the 3 to 15 μm wavelength range. When used with high-brightness infrared synchrotron radiation, the spatial resolution for these instruments is several microns, as expected for the limits imposed by diffraction. These diffraction effects can be readily observed when attempting to image the sharp edge of an absorbing material. Figure 1 shows the measured sharpness of an edge when imaged with 6 μm wavelength light (solid circles). Also shown is the edge profile predicted by a diffraction calculation (dashed line). Using a 10% to 90% height criteria, the spatial resolution is about 12 μm . Operating the system in a confocal mode (dual apertures) is expected to improve the spatial resolution by a factor of 3, but with a loss in S/N due to poorer optical throughput. The measured and calculated results for the confocal case are shown in Figure 2. Though the edge is about 3 times sharper, the data show additional scatter and interference effects when compared with the single aperture case. Additional tests will be needed to determine what degree of resolution enhancement is feasible through deconvolution methods.

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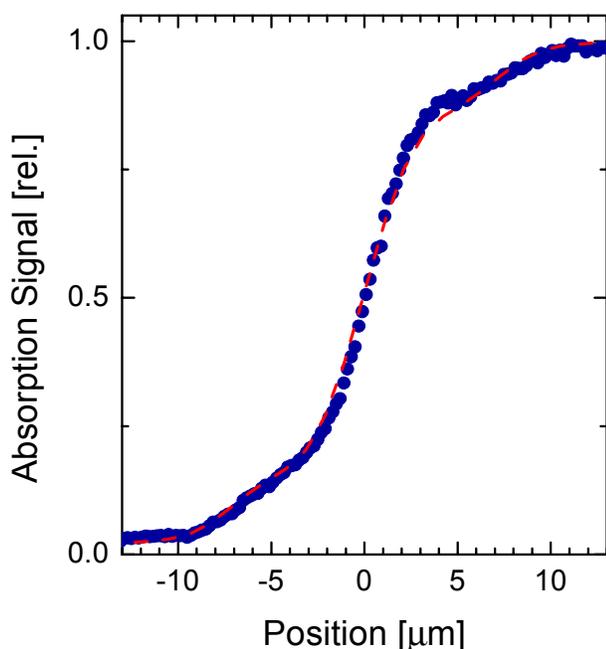


Figure 1. Edge profile for 6 μm wavelength light and a single aperture optical arrangement. Both measured (solid circles) and calculation (dashed line) are shown.

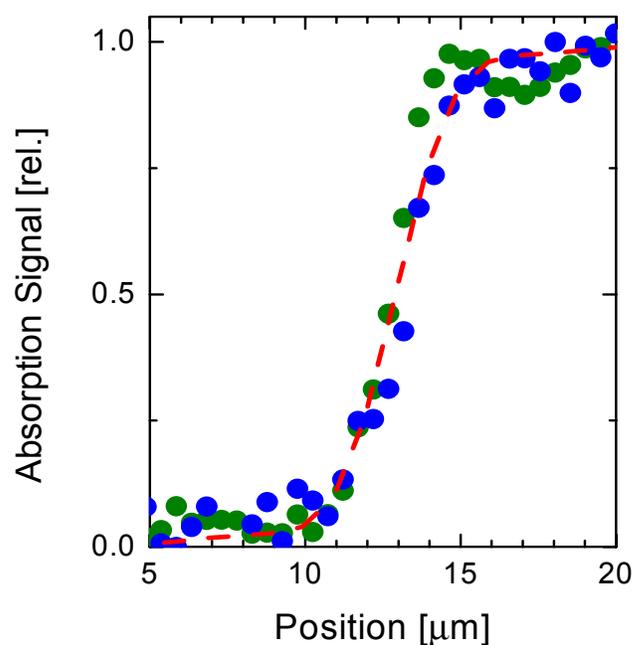


Figure 2. Edge profile for 6 μm (green circles) and 7 μm (blue circles) wavelength light for the dual aperture (confocal) optical arrangement. The calculated resolution for $\lambda = 6 \mu\text{m}$ is shown as the dashed line.