A Simple X-Ray Focusing Mirror Using Float Glass *	X13

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In our recent x-ray photon correlation spectroscopy (speckle) experiments at NSLS, one of the challenges is to increase the coherent photon flux through a pinhole, whose size is chosen to match the beam's horizontal transverse coherence length l_h. We adopted an approach to vertically focus the x-ray beam so as to match its vertical transverse coherence length l_v (at NSLS X13, $l_v \sim 50 l_h$, $l_h \sim 12$ μm at 3 KeV) with l_h. By demagnifying the vertical size by a factor of l_v/l_h, we expect to increase the intensity of the x-rays through the pinhole by the same factor while keeping the beam coherent.

A piece of commercial 3/8" thick float glass, by virtue of its low surface roughness ($\sim 3\mathring{A}$ rms), good reflectivity in the low photon energy range of interest and low cost, was chosen as the mirror material. A computer controlled motorized bender with a four point bending mechanism was designed and built to bend the float glass to a continuously variable radius of curvature from -700m (intrinsic curvature of the glass surface) to $<$ 300m, as measured with the Long Trace Profiler at the BNL Metrology Lab. This mirror bender assembly allows us to continuously change the focal length of the x-ray mirror down to 0.5 m under our experimental conditions.

At the NSLS X13 Prototype Small Gap Undulator (PSGU) beamline, we were able to focus the x-ray beam from a vertical size of 0.5 mm to $\sim$25 μm at the focal point 54 cm from the mirror center, thus increasing the photon flux density by a factor of 20. Results also show that, as expected, at an incident angle of 9 mrad, the mirror cuts off the harmonics of the undulator spectrum, leaving a clean 3 KeV fundamental for our experiments.

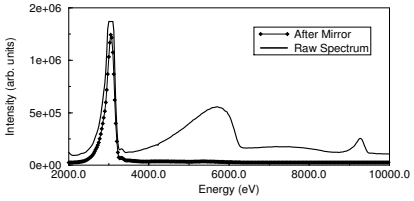

Figure 1. X13 PSGU spectrum before and after the mirror. The mirror (tilted at 9 mrad glancing incident angle) "cuts off" the higher harmonics, leaving a clean 3.1 KeV fundamental for the XPCS experiment.

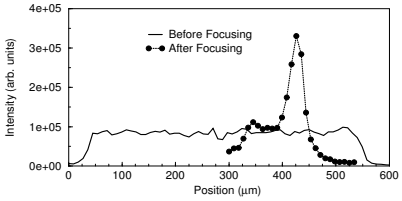

Figure 2. Vertical focusing by the float glass mirror. An incident beam of 0.5mm vertical height is focused to 25 μm (FWHM).

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