A Compact Point Focusing Spatial Filter for Microfocused X-ray Fluorescence Studies

E. A. Behne,[1] Y. Feng,[1] G. T. Seidler[1,2,*]

[1] *Physics Department, University of Washington, Seattle, WA, U.S.A.*

[2] *PNC-CAT Sector 20, Advanced Photon Source, Argonne, IL, U.S.A.*

** Author to whom correspondence should be addressed, seidler@phys.washington.edu*

Introduction

Appropriately selected absorbers combined with spatial filters are frequently used as x-ray low-pass filters in inelastic x-ray scattering studies and x-ray fluorescence spectroscopies. Using electric discharge machining, we have constructed a compact point-focusing spatial filter (PFF) with a large collection solid angle. Further, when used as a component in an x-ray low-pass filter, this instrument has excellent rejection of fluorescence from the absorber. We anticipate that this instrument will have regular application in x-ray microscopies where momentum resolution is irrelevant, such as in measurements of fluorescence-mode x-ray absorption fine structure using microfocused beams.

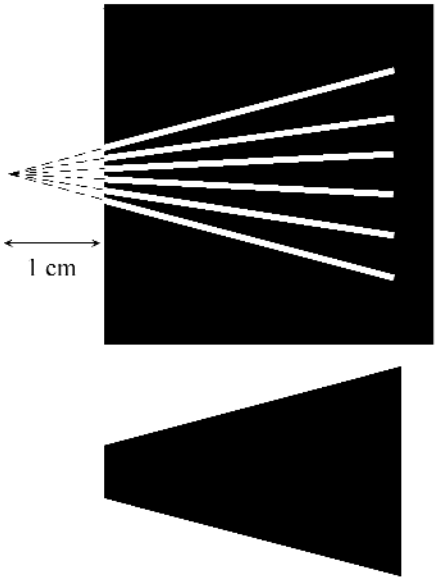

FIG. 1. Schematic drawings of (top) the vertical plates and (bottom) the horizontal plates.

Methods and Materials

Our PFF consists of 23 interlocking 0.25-mm-thick W plates assembled in an Al frame. Both the W plates and the slots in the Al frame were cut using a computer-controlled wire electric discharge machine, which produced cuts with a width of 0.30 mm. As shown in Fig. 1, the 11 slotted vertical plates are rectangular in shape, with six slots cut in each of them to hold the trapezoidal horizontal plates.

In Fig. 2, we show front and back views of the assembled PFF. Each side of the frame has a pair of opposing slotted Al pieces, each with 5 slanted EDM cuts—the vertical plates fit into these slots, and one vertical plate also is held between the two pieces of the frame. When assembled, the PFF channels are 3 cm deep, with a working distance of 1 cm. The total PFF collection angle is 60 deg wide horizontally and 30 deg high vertically. After correcting for the thickness of the W plates, the PFF has a total collection solid angle of 0.3 sr. A low-pass filter is formed by pressing a metal foil across the entrance aperture of the PFF.

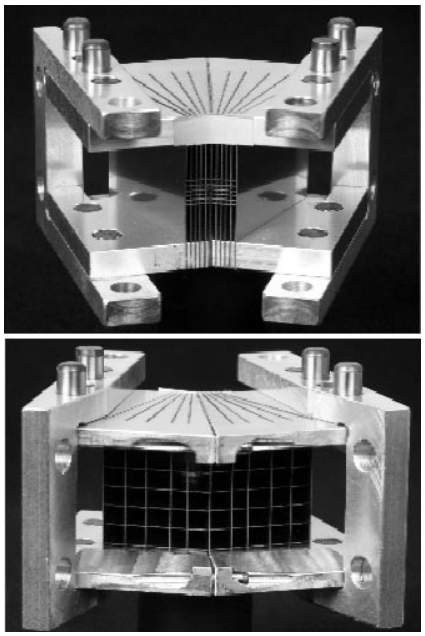

FIG. 2. A front view (top) and back view (bottom) of the point-focusing spatial filter.

Results

Based on the PFF geometry, we calculate a relative efficiency of ~2000 for detection of intensity from photons with energy below the edge of the absorber compared to those with energies above the edge. Complete details of this calculation and of general considerations for the design of PFF's has been presented elsewhere.[1] We have also successfully combined a low-pass filter using the PFF with the energy-scanning capability of our beamline to make a convenient filter-based analyzer suitable for some measurements of inelastic x-ray scattering.[1]

Acknowledgments

The operation of the PNC-CAT beamlines is supported by the U.S. Department of Energy, Basic Energy Sciences, and by the NSERC in Canada. The operation of the Advanced Photon Source was supported by the U.S. Department of Energy, Basic Energy Sciences, Office of Science, under contract No. W-31-109-Eng-38. Also, G.T.S. acknowledges support from the Research Corporation as a Cottrell Scholar.

Reference

[1] E.A. Behne, Y. Feng, and G.T Seidler, "A Compact Point Focusing Spatial Filter for X-ray Fluorescence and Inelastic X-ray Scattering Studies," submitted to Rev. Sci. Instrum.