B27

Performance of cryogenically cooled silicon-crystal monochromators under high power loads

C. S. Rogers, D. M. Mills, L. Assoufid, and T. Graber
Advanced Photon Source, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439

The performance of two Si crystal x-ray monochromators internally cooled with liquid nitrogen was tested on the F2-wiggler beamline at the Cornell High Energy Synchrotron Source (CHESS). Both crystals were (111)-oriented blocks of rectangular cross section with identical dimensions. Seven 6.4-mm-diameter coolant channels were drilled through the crystals along the beam direction. In one of the crystals, porous Cu-mesh inserts were bonded into each channel to enhance the heat transfer. The channels of the second crystal were left as drilled. Symmetric double-crystal rocking curves were recorded simultaneously for both the first and third order reflections at 8 and 24 keV. The power load on the cooled crystal was adjusted by varying the horizontal beam size using slits. The Si(333) rocking curve of the unenhanced crystal at 24 keV for a low power beam was 1.9 arcsec. The theoretical width is 0.63 arcsec; the difference was due to the result of residual fabrication and mounting strains. At the maximum incident power of 601 W and average power density of about 9 W/mm^2, the rocking curve was 2.7 arcsec. The rocking curve for the enhanced crystal at low power was 2.45 arcsec. At a maximum incident power of 1803 W with an average power density of about 17 W/mm^2, the rocking curve was 2.2 arcsec. Less than 1 arcsec of thermal-induced broadening was observed for the unenhanced crystal at the maximum power, and no systematic thermal-induced broadening was detected for the Cu mesh-enhanced crystal.

This work is supported by the U.S. Department of Energy, BES-Materials Sciences, under contract No. W-31-109-ENG-38.