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$TaSi_2$-Si composites as wide-bandpass optical elements for synchrotron radiation

Stuart R. Stock
School of Materials Sci. & Eng., Georgia Institute of Technology, Atlanta, GA 30332-0245, USA

Hans-Bernd Neumann, Joerg Suessenback, and Jochen R. Schneider
HASYLAB am DESY, Notkestrasse 85, D-22607, Hamburg, Germany

Zofia U. Rek
SSRL, P.O. Box 4349, Bin 69, Stanford, CA 94309-0210

The wide matrix rocking curves of the *in situ* eutectic composite $TaSi_2$-Si make it attractive as a wide-bandpass monochromator for synchrotron radiation. Wafers with 111_{Si}, 110_{Si}, or 100_{Si}, orientation were studied to determine the origin of the wide rocking curves. The high degree of preferred orientation of the $TaSi_2$ rods relative to the Si matrix was examined using synchrotron Laue patterns and the 100_{TaSi2}, 003_{TaSi2}, and 102_{TaSi2} reflections. Double and triple axis diffractometry were used to show that the large widths were due to strain and mosaic and not long-range bending; copper radiation (for some double axis results) and 120 and 160 keV synchrotron radiation were used. At 8 keV, rocking curve widths were about twenty times broader than those from perfect Si, and peak reflectivities approached 20%. Rocking curves from 333_{Si} and 444_{Si} (120 and 160 keV, respectively) had identical profiles and reflectivities of about 25%. The triple axis results show compressive strains in the Si matrix along $[111]_{Si}$ (i.e., parallel to the rods) and dilational strains orthogonal to the rods. These results confirm the promise of $TaSi_2$-Si as a wide-band-pass optical element for synchrotron radiation.