B41

Phase space analysis of a 4-bounce high resolution monochromator

Mihai Popovici
Missouri University, Research Reactor, Research Park, Columbia, MO 65211

A high resolution monochromator for signal-to-background enhancement in coherent nuclear resonant scattering measurements with the ^{57}Fe resonance at 14.413 keV was recently proposed [1] and tested [1-3]. The monochromator consists of a nested pair of channel-cut silicon (422) and (10 6 4) crystals in (+n, +m, -m, -n) configuration. High angular acceptance is achieved by setting the (422) crystals in strongly asymmetric reflection. The monochromator throughput was found to be lower than anticipated [2]. Misalignments and surface roughness were suspected [2].

This paper considers the monochromator optics in the position-angle-wavelength phase space [4]. Distributions with respect to the third dimension that is not considered in DuMond diagrams (the spatial coordinate across the beam) turn out to be important for this consideration, especially for finite sources. The low throughput appears to be inherent to the given configuration. Phase space numerical computations indicate that the throughput can be significantly improved by slightly bending the outer (422) pair of crystals. The condition of strongly asymmetric reflection on the (422) crystals corresponds to the flat crystal limit of a general matching condition for bent crystal optics [5].

[1] T. Ishikawa, Y. Yoda, K. Izumi, C.K. Suzuki, X.W. Zhang, M. Ando and S. Kikuta, Rev. Sci. Instrum. 63(1)1015(1992).

[2] T.S. Toellner, T. Mooney, S. Shastri and E.E. Alp, SPIE Vol. 1740 Optics for High-Brightness Synchrotron Radiation Beamlines (1992) p.218.

[3] T.M. Mooney, T. Toellner, W. Sturhahn, E.E. Alp and S.D. Shastri, Nucl. Instr. and Meth. A347,348(1994).

[4] T. Matsushita and U. Kaminaga, J. Appl. Cryst. 13(1980)472.

[5] M. Popovici and W.B. Yelon, Nucl. Instr. and Meth. A319,141(1992).