Non-traditional Multilayer Kirkpatrick-Baez Optics for various laboratory applications

Part 1. Optic incorporating two different mirrors, Optic incorporating non-multilayer component, two-corners Optic.

Boris Verman, RIT, Inc, boris.verman@rigaku.com

Side-by-side multilayer Kirkpatrick-Baez optic became a common optical solution for single crystal diffractometry and small angle scattering systems. The second generation of the optic and x-ray sources with a smaller focal spot significantly improved these systems performances.

It was recognized at the same time that the approach is a quite flexible and with some variations in design and optimization can meet requirements of various other applications. Several examples will be described below.

1. Thin film diffractometry.

   A common combination of requirements is: a low divergence of the beam in the diffraction plane, a larger divergence is acceptable in the axial plane and a small beam cross section on the sample is preferable. A parabolic mirror is adequate to form the beam in the diffraction plane, but an elliptical mirror in axial plane is more optimal to meet the last two requirements. So, a side-by-side multilayer Kirkpatrick-Baez optic incorporating one parabolic and one elliptical mirror was designed, fabricated and tested.

2. A high convergent beam XRR.

   This version of specular XRR was suggested to speed measurements. A multilayer optic has some limitations to form a high convergence beam at a given distance because of its relatively large d-spacing. On the contrary, the crystals do not have such limitations having naturally smaller d-spacing. A possibility of construction of optic incorporating one multilayer mirror and Johansson crystal (hybrid optic) was analyzed. As a result, performances meeting the application expectation were predicted and two versions of a hybrid optic were assembled and tested.

3. Traditional XRR.

   Axial divergence of the incident beam does not affect the accuracy of reflectivity measurements. This allows to use two optics (or two corner optic) providing focusing with a higher convergence in the axial plane. This approach doubles the useful flux. Two corner optic was designed for XRR.

4. Dual wavelength crystallography.

   A possibility of conditioning of two different wavelengths by a single optical unit will be discussed, as well.