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X-ray Diffraction Image of a Low-Angle Twist Boundary

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According to the existing model, the low-angle twist boundary is a two-dimensional superlattice, formed by a net of two mutually perpendicular arrays of screw dislocations, so that in a given array the dislocations have the same Burgers vectors. In this work, we study the problem of spherical X-ray wave diffraction by a crystal with a low-angle twist boundary perpendicular to the crystal surface in Laue geometry. Since in this geometry the diffraction vector is perpendicular to the Burgers vector of one of the screw dislocation arrays, the problem is reduced to diffraction by a one-dimensional superlattice. In [1] it is shown that due to the phenomena of specular and total internal reflection and waveguide propagation of radiation along the dislocation wall, focusing inside the crystal occurs not only at a depth corresponding to an ideal crystal, but also at shallower depths.
As is known, at the diffraction of a spherical X-ray wave by a single crystal in the Laue geometry, the phenomenon of focusing of the weakly absorbed mode of the diffracted wave field occurs both inside and outside the crystal - in vacuum. In this work, the behavior of the diffracted wave behind the crystal is investigated. It is shown that at the diffraction of a spherical X-ray wave on a crystal with a low-angle twist boundary perpendicular to the crystal surface in the Laue geometry the wave, propagating behind the crystal is focused not only at a distance corresponding to the focal length for an ideal crystal, but also at greater distances. In this case, the farther the focus is from the exit surface of the crystal, the lower is its intensity.

References:
1. L.V. Levonyan and H.M. Manukyan. Journal of Contemporary Physics (Armenian Academy of Sciences), 2024, 59(2), 214-218.

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