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X-ray Diffraction Study of Deformation Fields Induced by Temperature Gradient in Single Crystals

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As is known, the correct choice of the deviation function is very important in order to obtain a certain intensity, spectral and spatial distribution in the diffracted beams formed as a result of X-ray diffraction in deformed crystals. To describe the deviation function, it is sufficient to provide the dependence of the bending radius and interplanar distances of the reflecting atomic planes on the coordinate.
In this paper, the deviation function of the deformation field in a crystal caused by an external temperature gradient was investigated using the narrow collimated polychromatic beam X-ray diffraction method.
A rectangular parallelepiped plate made of an X-cut quartz single crystal was used one of the edges (heated) of which was parallel to the reflecting planes (101¯0). To determine the deformation field formed in the sample at different temperature distributions, topograms of the cross-section of the beam reflected from (10-10) reflecting atomic planes in Laue diffraction geometry at different distances from the sample were recorded using a coordinate detector with a resolution of 55 μm. To provide different temperature distributions in a crystal, a special device was prepared, allowing to move the thin heating spiral, parallel to the lateral surface of the sample.
As a result, the average values of the bending radius and interplanar distance of the reflecting atomic planes in the direction of beam propagation in the single crystal were determined for different positions of the heater. It was shown that the spectral width of the reflected beam and the spatial distribution of the spectrum in the beam strongly depend on the position of the heater.

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