s4.m1.p7 Significant improvement in contrast and information value of images of defects in crystals. A.A. Zholudev, V.N. Trushin, Y.V. Chuprunov, Al.F. Khokhlov *Nizhny Novgorod State University, Physics Department, 23 Gagarin av.,box 3 (NiPTI) office 402, Nizhny Novgorod, Russia E mail:zhol@phys.unn.runnet.ru,http://phys.unn.ru nnet.ru*
Keywords: X-ray image, topogram, inhomogeneous thermoinduced deformations.

This paper describes the method for producing topograms of crystals when their surface is illuminated by optical light. The experiment was carried out using a two-crystal X-ray spectrometer (CuKα_1 radiation, GaAs (511) monochromator, non-symmetrical Bragg setup). The structure of X-ray diffraction maximums of $NaNO_3$, ZnO_2 and SBN (x=0,25) crystals was recorded on the photographic plate in the form of topograms. Under spatially homogeneous optical illumination of the pre-blackened diffracting crystal, the illuminated crystal surface was heated by 11^o Centigrade ($\partial T/\partial x$ = 20^o/cm) and the temperature of the crystal remained constant during the experiment. The opposite surface of the specimen was pressed to the surface of the metal holder ("cooler") whose temperature was set and maintained with the accuracy of $\Delta t = \pm 0{,}1^o$C Centigrade.

In studying the topograms, some specific features in the variation of the dislocation contrast have been observed that were related to the illumination (temperature gradient) of the crystal. These features include the emergence of some local regions of kinematic scattering (higher-intensity regions) near some defects.

When light is absorbed by the crystal surface, a temperature gradient arises in it. The gradient is directed at a certain angle relative to the vector of the reverse lattice. Inhomogeneous elastic thermal deformations are brought about in the crystal layer taking part in the diffraction of X-rays. The distribution of such deformations reflects the defect structure of the defects on its surface. The change of the diffraction contrast of defects image on the topogram is determined by the local changes in the X-ray diffraction in the vicinity of each defect. Local changes of X-ray diffraction in the crystal are determined by the superposition of static stresses caused by the presence of defects in the crystal that affects its elastic characteristics. The described method for obtaining topograms allows improving the information value of the image of crystal defect structure.

s4.m1.p8 X-Ray dynamical diffraction: the concept of locally plane wave. Y. Epelboin[1] & V. Mocella[2] . [1]*LMCP, UMR 7590 CNRS, Universités P.M. Curie et D. Diderot, case 115, 75252 Paris cedex 05, France,* [2]*ESRF, BP220, 38043 Grenoble Cedex, France.*
Keywords: dynamical theory, high-precision diffraction, characterization.

The usual formulation of X-Ray dynamical theory considers two cases: either a point source located at infinity (plane wave) or a point source located on the surface (spherical wave). To properly treat new-generation synchrotrons sources, one must take the coherence properties of the source into account and locate the source at a finite distance from the crystal.

We will consider a source located at a large distance (145 m) which is the case of the ID19 station at ESRF and discuss how the diffraction profile is affected by the source size and by the wavelength bandwidth. We will explain why the crystal locally "sees" a plane wave and how the intensity profile reproduces the rocking curve of the crystal with a local correspondence between the position in the image and the angular deviation from the Bragg condition. These features are valid only if certain relationships between the crystal thickness, the source to crystal distance, the wavelength and bandwidth are fulfilled.

Experiments performed at ID19 have verified this theory. The fringes in the image reproduce the oscillations of the rocking curve. When the crystal is shaped as an edge they appear as hyperbolic fringes. The position of the fringes is very sensitive to the local departure from Bragg angle, which allows a new kind of high-precision diffraction experiments.

The fringes draw, for instance, a map of the local deformation near a defect. We will present images of point-defects, dislocations or scratches and show how it is possible to quantitatively characterize these defects by the analysis of the shape and color of the fringes.

Introducing an edge shaped object in a part of the X-Ray beam impinging on the crystal modifies the path of the rays, thus the phase of the incoming wave. This induces a shift in the position of the fringes in the corresponding part of the image. Measuring this shift allows to measure the refractive index of the materials. Preliminary experiments are in good agreement with known values.

V. Mocella, Y. Epelboin & J.P. Guigay, Acta Cryst. A, 2000, in the press.