11.1–27   INVESTIGATION OF X-RAY POLARIZATION
           EFFECTS IN DOUBLE-CRYSTAL TOPOGRAPHY.

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Double-crystal topography in the Bragg case was
performed using synchrotron radiation and the
new double-axis X-ray diffractometer (Nucl.
Instr. and Meth.,190,593(1981)) installed at
DORIS II/HASYLAB. With this instrument the
reflecting plane of the double-crystal set
C1 (reference crystal)-C2 (sample crystal) can
be rotated continously with respect to the re-
flecting plane of the monochromator (two inde-
pendent perfect Si crystals). Rotation axis is
the beam incident on C1. It is thus possible
to align the whole topographic set-up (crystals
C1, C2, two monitor detectors and the film
cassette) in the Bragg geometry for a given
Θ_B^S angle on the inner bench of the diffracto-
meter and to change the inclination angle α of
the reflecting plane C1-C2 with respect to the
polarization plane of the primary beam by
rotating the bench about the monochromatic beam
direction. For such a variation of α changes of
the rocking curves widths (Γ_{RC} when rocking C1
and Γ_S when rocking C2) and changes of the
penetration depth t_e of the beam during the re-
flection process have been predicted (Nucl.
Instr.andMeth.,208,(1983)) when rocking of the
strong α-dependence of relative σ and π con-
tributions to the total reflecting power of the
crystals. The effects should be the more pro-
nounced the higher is the degree of polari-
zation of the incident monochromatic beam and
the closer to 45° is the sample Bragg angle Θ_B^S.
The continous spectrum of the synchrotron ra-
diation, its high initial degree of polari-
zation (about 90%) and different combinations
of reflections at the monochromator, C1 and C2
offered unique opportunities to study the pro-
blem at a variety of conditions nearly ful-
filling both requirements.
Trial experiments for some almost perfect Si
crystals with symmetric and/or asymmetric cuts,
different reflections like (440),(551),(331),
(422), some Θ_B^S in the range 39° to 51° (and λ
in the range 0.63 Å to 1.92 Å respectively) and
different α angles were carried out. Utilising
reflections (400) or (800) and monochromator
Bragg angles Θ_B^M very close to 45° in order to
produce the monochromatic beam, its degree of
polarization could be improved above the one
given by the source itself. At such improved
conditions and α angles close to 0° the
measured rocking curves displayed a complex
character (σ and π contributions superposed),
the widths Γ_S (about one to two order of
magnitude smaller than Γ_{RC}) decreased signi-
ficantly for α approaching 0° and changes of
topographic patterns were noticed. The patterns
revealed the existence of some minute lattice
strains connected with the crystal growth.
The results seem to show that in a thin layer
near the surface the stresses caused during
the growth process are allowed to relax into
minute strains which then are imaged on topo-
graphs.

Thus by taking topographs with different pene-
tration depths t_e a variation of lattice de-
formations below a crystal surface can be
explored.

11.2–1   DETERMINATION OF STRAIN DISTRIBUTIONS AND
          FAILURE PREDICTIONS BY NOVEL X-RAY METHODS.

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A number of X-ray methods were developed which make it
possible to determine the distribution of elastic and
plastic strains emanating from stress raisers. The de-
termination of elastic strains is made by measurements
of reflected intensities and rests on the theory relating
the integrated reflectivity to lattice curvature. The
theory covers the entire range from zero to infinity and
takes into account, anomalous transmission and crystal
anisotropy (Z. H. Kalman & S. Weissmann, J. Appl. Cryst.
(1983) 16, 295). Using silicon as model material, strain
gradients and strain distributions were measured from
bent crystals containing stress raisers and the results
were compared to calculations based on continuum me-
chanics. Good agreement was obtained between experiment
and theory. The distribution of plastic strains is de-
termined by double crystal diffractometry using a com-
puter-aided rocking curve analyzer (CARCA). The plastic
zones at the notch tips were mapped in terms of contour-
lines of excess dislocation densities and it was shown
that in tensile-deformed, double-notched silicon the
mapping of microplasticity by CARCA leads to the early
disclosure of the future fracture path. Aided by
pendellösung topography it was shown that strain hardened
microplastic zones constrain residual, elastic strains
and that the degree of strain hardening governs the mag-
nitude of residual strains. Extending the results of
single crystal studies and CARCA method (Yazici, Mayo,
Takemoto & Weissmann, J. Appl. Cryst. (1983) 16, 89), to
commercial aluminum alloys, cycled in air, and in cor-
rosive environment, the accrued damage is determined and
failure predictions are made nondestructively.

11.2–2   THE EFFECT OF REAL STRUCTURE OF
          GARNET ON ITS OPTICAL AND
ELECTRICAL PROPERTIES. By A. P. Andreev,
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rov, USSR.

Electrical conductivity relation to tempera-
ture does not always follow the law of

$$\sigma = \sum_{i=1}^{i=n} \sigma_i e^{-E_i/kT}$$ in real crystals where

$E_i < E_{i+1} < ... < E_n$, though it is stated valid
for ideal non-metal crystals. The cause of
this is seen in processes of recapture of
charge carriers by some defect trap levels
as well as in chemical and physical transfor-
mations and in effects of concentration and
charge gradients.

Studies have been made on $Y_3Al_5O_{12}$ and on
$(TR_x, Y_{1-x})_3Al_5O_{12}$ obtained by horizontally
directed growth technique (TR — Dy^{3+}, Lu^{3+},
Eu^{2+}).

Optical absorption spectra of these crystals
in the range of 400–50000 cm^{-1} may be under-
stood in known scientific graphology. The
fine structure of Dy^{3+} spectrum (local sym-
metry D_2) is thought to be conditioned by
forbidden transitions in the 4f-shell. The
broad absorption bands observed at heterova-
lent substitution $Y^{3+} \rightarrow Eu^{2+}$ are in agree-