PROC. JSSF-2, KYOTO, 1980
J. PHYS. SOC. JPN. **49** (1980) SUPPL. B, pp. 155–156.

Light Deflections from Ferroelastic Domains

Takeyo TSUKAMOTO, Jun HATANO and Hideo FUTAMA

Department of Applied Physics, Faculty of Science,
Science University of Tokyo, Kagurazaka,
Shinjuku-ku, Tokyo 162

The intensity distribution of the Fraunhofer diffraction from a domain wall of ferroelectric gadolinium molybdate has been observed and the domain wall thickness has been estimated by Suzuki.[1] Recently, Laikhtman and Petrov[2] discussed the problem of diffraction of an electromagnetic wave by a domain wall in a ferroelectric in connection with the domain wall thickness.

In this paper, we report the experimental results for light diffraction or deflection from a multi-domain crystal divided by 180° walls in some ferroelectrics and ferroelastics.

Fig. 1(a) shows a deflection pattern of light obtained by the use of a He-Ne laser for an *a*-plate of Rochelle salt crystal in the ferroelectric phase. The domain structure observed by means of a polarization microscope is shown in Fig. 1(b). Spots in the Fig. 1(a) correspond to the lights deflected vertically from *c*-domains and horizontally from *b*-domains. The deflection does not occur in single domain state and in paraelectric states. The intensity of the deflected light is in proportion to the square of the spontaneous polarization. No deflection of this kind can be observed in *b*- and *c*-plate.

Figure 2 shows the dependence of the angle of deflection on the angle of incidence in Rochelle salt. The angle of deflection is 4.2° for the incident direction perpendicular to the specimen. Two kinds of deflected light were observed which are labeled by A and B in the figure. Both of them are almost plane polarized. The planes of vibration of A and B are parallel to the *ab*- and to the *bc*- plane, respectively.

This kind of deflection has been observed also in $RbHSeO_4$ at room temperature and in $KH_3(SeO_3)_2$ below −61°C. In the typical ferroelectric but non-ferroelastic crystals, such

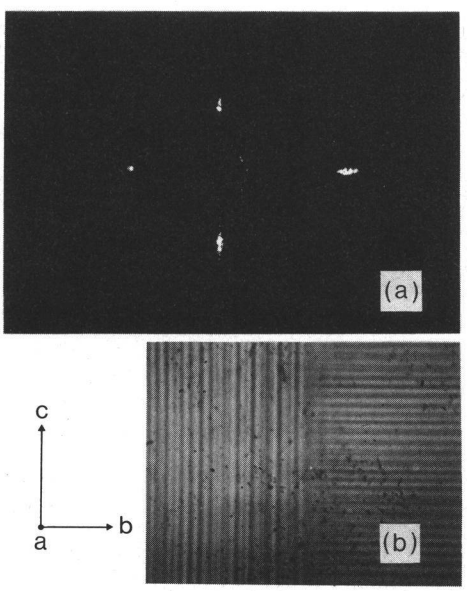

Fig. 1. (a) A deflection light pattern of Rochelle salt observed at 18°C. (b) Domain structure of the same specimen.

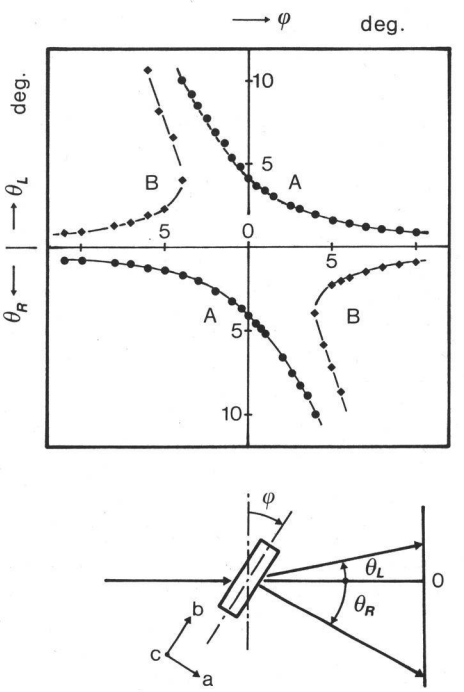

Fig. 2. The angle of deflection θ vs the angle of incidence φ. The definitions of φ, θ_L and θ_R are shown in the bottom.

as TGS and $NaNO_2$, however, the light deflection does not occur. It can be considered that the peculiar deflection of light is due to domains or domain walls in ferroelastic crystal with spontaneous shear strain. In $RbHSeO_4$, an additional spot which correspond to reflection light from the domain wall has been observed. It can be said that the refractive index of this crystal varies discontinuously at the domain wall.

These deflection phenomena cannot be explained by grating effect of the domain walls not only quantitatively but also qualitatively. Crystal optics including biaxial properties should be taken into account. Further investigations to clarify these phenomena are in progress.

References

1) S. Suzuki: Solid State Commun. **11** (1972) 937.
2) B. D. Laikhtman and V. Yu. Petrov: Sov. Phys.—JETP **46** (1977) 628.