Doctoral Thesis

Elastizität von piezoelektrischen und seignetteelektrischen Kristallen

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Publication Date:
1950

Permanent Link:
https://doi.org/10.3929/ethz-a-000098712

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Elastizität von piezoelektrischen und seignetteelektrischen Kristallen

VON DER
EIDGENÖSSISCHEN TECHNISCHEN HOCHSCHULE IN ZÜRICH
ZUR ERLANGUNG
DER WÜRDE EINES DOKTORS DER NATURWISSENSCHAFTEN
GENEHMIGTE
PROMOTIONSARBEIT
VORGELEGT VON
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Basel
Buchdruckerei E. Birkhäuser & Cie., AG.
1950
Summary. The object of the present investigation is the application, to piezoelectric and ferroelectric crystals, of the Schaefer-Bergmann method for the measurement of the elastic constants of transparent bodies by observing the diffraction of light on supersonic waves. The elastic behaviour of Rochelle salt is investigated as a function of temperature in the range between $-50^\circ$ and $+30^\circ$ C. All elastic constants, with the exception of $c_{44}$, turn out to behave quite normally in the investigated temperature range. The constant $c_{44}$ could not be measured because of the very strong damping which affects the corresponding elastic wave and leads to an incomplete diffraction pattern for light incident along the ferroelectric a-axis. The agreement between the values of elastic constants measured by the author and those given by the literature for room temperature is highly satisfactory.

The elastic behaviour of the ferroelectric crystals $\text{KD}_2\text{PO}_4$ and $\text{RbH}_2\text{PO}_4$ as well as of the piezoelectric crystal $\text{NaClO}_3$ is investigated by the same supersonic method. The measurements obtained with $\text{NaClO}_3$ yield an excellent agreement with the results of Mason.

The application of the Schaefer-Bergmann method to the ferroelectric crystals investigated here raises the point whether one obtains in this way the elastic constants at constant electric field ($c_{ik}^E$) or the elastic constants at constant dielectric displacement ($c_{ik}^D$). A theoretical argument shows that the constants $c_{ik}^E$ are obtained. This conclusion confirms the results obtained by Zwicker with $\text{KH}_2\text{PO}_4$, according to which the constant $c_{66}$, as measured by the Schaefer-Bergmann method, is subject to a strong anomaly at the Curie point.

Finally some particular questions connected with the intensity of the observed diffraction patterns are discussed. The non-observation of certain figures predicted by theory for the diffraction pattern is explained. Further, an explanation is given on the basis of an elasto-optical argument for the experimentally observed fact that with equal excitation of a $\text{KH}_2\text{PO}_4$-crystal a much stronger diffraction pattern is obtained with light incident along the optical c-axis than with incidence parallel to the a-axis.