11.7.6 ACCURATE DETERMINATION OF THE STRUCTURE FACTORS OF ALPHA-QUARTZ. By K. Kobayashi, T. Takama and S. Sato, Faculty of Engineering, Hokkaido University, Kita-ku, Sapporo 060, Japan.

The structure factors of α-quartz are accurately determined by the method measuring X-ray Pendellösung intensity beats of white radiation diffracted from perfect single crystals. This technique does not require the intensity measurement in absolute unit and therefore no corrections for extinction etc. are necessary (T. Takama, M. Iwasaki and S. Sato, Acta Cryst., 1980, A36, 1025-1030; T. Takama, N. Noto, K. Kobayashi and S. Sato, Jpn. J. Appl. Phys., 1983, 22, L304-L306). Six parallel-sided wafers with {11$\bar{2}$0}, {10$\bar{1}$0} and {0001} surfaces and 0.5~1.0mm in thickness were cut from synthetic single crystal blocks for the commercial use as quartz oscillators. An X-ray topographic examination revealed that neither planar defects such as Dauphiné twins or stacking faults nor dislocations are included.

Figure 1 shows an example of the measured Pendellösung beats of 10$\bar{1}\bar{1}$ reflection corrected for the incident beam spectrum and geometrical and absorption factors. The structure factors were determined from the extremum positions of the beats, such as in Fig. 1, for 21 reflections from 10$\bar{1}$0 to 10$\bar{1}\bar{5}$. The ratios of $|F_{hkil}|/|F_{hki\bar{l}}|$ in the present work agree very well with those from the measurement of thickness fringes on the topograph (K. Yamamoto, S. Homma and N. Kato, Acta Cryst., 1968, A24, 232-237), but slightly differ from those by the measurements of integrated intensity (W.H. Zachariasen and H.A. Plettinger, Acta Cryst., 1965, 18, 710-716; R.A. Young and Ben Post, Acta Cryst., 1962, 15, 337-346). A discussion is made on the position of Si and O atoms as well as on the anisotropic thermal vibrations based on the measured structure factors. The authors are greatly indebted to Messrs. M. Tsukada and O. Oyamada for their assistance. The research is partially supported by the Ministry of Education, Science and Culture, in Japan under the Grant-in-Aid for Developmental Scientific Research, No. 60850119.

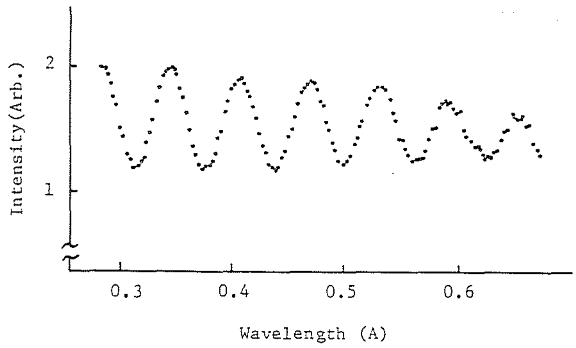

Fig. 1 An example of measured Pendellösung beats. SiO_2, 10$\bar{1}\bar{1}$ reflection, t=505 μm.

11.7-7 MEASUREMENTS OF THE X-RAY PENDELLÖSUNG BEATS FROM ELASTICALLY BENT SILICON SINGLE CRYSTALS. By T. Takama, K. Kobayashi and S. Sato, Department of Applied Physics, Faculty of Engineering, Hokkaido University, Kita-ku, Sapporo 060, Japan.

The present authors have reported that Pendellösung intensity beats can be measured on the wavelength scale by using white radiation and parallel-sided single crystals (T. Takama, M. Iwasaki and S. Sato, Acta Cryst. 1980, A36, 1025-1030). In the present work an attempt is made to investigate the effect of uniform elastic strain on the Pendellösung interference phenomenon using the above modern technique. An isosceles triangular shaped (111) single crystal wafer was cut from a dislocation free FZ silicon ingot. Uniform bending was performed by pushing slightly the apex of the triangular wafer with fixed base perpendicular to the surface by using a differential micrometer screw. A measurement of surface curvature revealed that the specimen was bent uniformly. The specimen was then set on an X-ray goniometer together with the bending device so as to be irradiated by collimated white X-ray beam from a high power generator (120kV, 170mA).

Figure 1 is an example of a series of as-measured 3$\bar{1}\bar{1}$ Pendellösung intensity beats showing the effect of uniform bending. As the curvature, $1/\rho$ (ρ: radius of curvature), increases, the following change can be clearly observed: (1) The intensity increases especially in the short wavelength range. (2) The extremum positions move to the shorter wavelength side. (3) The amplitude of intensity beats decreases and finally the beat smears out. A similar phenomenon was also observed for $\bar{1}$11, 1$\bar{1}\bar{1}$, $\bar{3}$11, 4$\bar{2}\bar{2}$, $\bar{4}$22 and other reflections. The present experimental results were discussed in detail in comparison with the dynamical theory for distorted crystal using the eikonal approximation (N. Kato, J. Phys. Soc. Japan 1964, 19, 971-985). A fairly good agreement is drawn between the theory and experiment.

The authors acknowledge the valuable advice of Professor N. Kato. They also thank to Messrs. K. Tsuchiya and N. Ichijo for their assistance in the experiment.

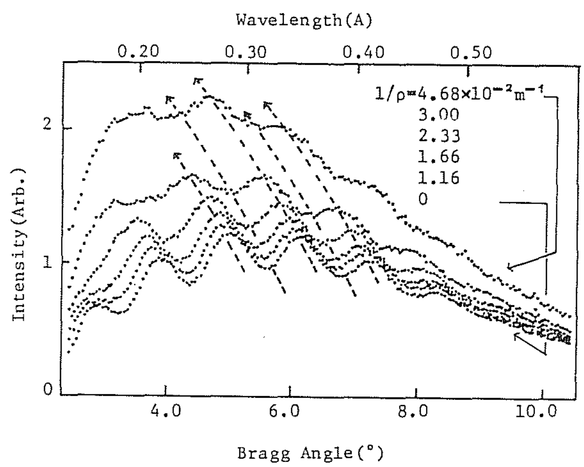

Fig. 1 Change in Pendellösung beats of 3$\bar{1}\bar{1}$ reflection due to uniform elastic bending.