

Growth Pyramid and Domain Reversal of Dicalcium Strontium Propionate $\text{Ca}_2\text{Sr}(\text{C}_2\text{H}_5\text{CO}_2)_6$

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Dicalcium strontium propionate $\text{Ca}_2\text{Sr}(\text{C}_2\text{H}_5\text{CO}_2)_6$ (DSP) is ferroelectric below the Curie point of 8.5°C . The space group of the paraelectric state is $D_4^{4(1)}$ and that of a ferroelectric state is $C_4^{2(2)}$. There exists another ferroelectric state below the second transition point of -169°C , the point group being determined as C_2 .³⁾ It was found⁴⁾ that antiparallel domains in a ferroelectric C_4 -phase of DSP are visible in polarized light travelling along the $[001]$ axis, although the phase is optically uniaxial. The domains with opposite polarity are distinguished as pseudo-octagonal islands with dark and bright contrast, the antiparallel domains having different extinction positions. This phenomenon offers an interesting problem for understanding the relation between domain reversal and crystal texture.

We have given a new interpretation of the visibility of antiparallel domains as due to the spontaneous dissymmetrization of growth pyramids.⁵⁾ This paper reports optical and X-ray evidences supporting the above conclusion. The inspection under the polarizing microscope revealed that the specimen has a texture of growth pyramid consisting of four growth sectors. Each sector of the growth pyramid manifests a deformed conoscopic pattern from the uniaxial one. In order to clarify the dissymmetrization due to the growth pyramid texture, X-ray studies were performed. X-ray two dimensional reciprocal lattice method⁶⁾ was employed to investigate how lattice spacings and the orientation of growth sectors are changed by the positions of the specimen. As an example of results, the change in the lattice spacing d_{110} and the change in the lattice orientation $[110]$ at -94.7°C are shown in Fig. 1(a) and (b) respectively, as a function of positions in the vicinity of the boundary between two growth sectors. As schematically depicted in the figure the boundary is defined as $L=0.0$ mm.

The results are summarized as follows: (1) the lattice contraction occurs at the boundary, $\Delta d/d$ being -1.0×10^{-5} ; (2) the lattice orientation

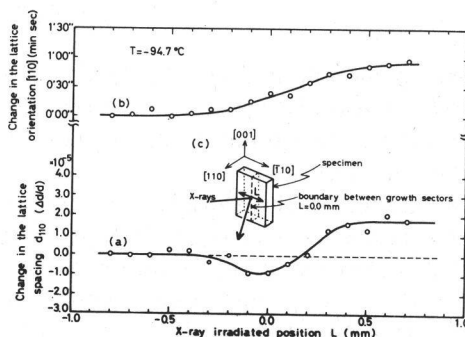


Fig. 1. (a) Change in the lattice spacing $\Delta d/d$ in the $[110]$ direction as a function of the X-ray irradiated position L . (b) Change in the lattice orientation $[110]$ as a function of the X-ray irradiated position L . (c) Schematic illustration of the specimen and the X-ray irradiation.

rotates by $50''$ each other in both sides of the boundary; (3) the lattice is deformed slightly from the tetragonal one, the deviation of the axial ratio b/a from unity being 2.5×10^{-5} and that of the axial angle γ from 90° being $0'3.1''$.

It is concluded that the specimen of the present experiment becomes slightly deformed from the tetragonal form due to the dissymmetrization of the crystal growth. In this case, the specimen can be birefringent along the $[001]$ direction. Thus it is clarified that the origin of the visibility of the antiparallel domains of DSP is due to the perturbed deformation induced by the growth pyramids.

References

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