Unusual effects during diffraction of electrons on $BaTiO_3$ single crystals

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The research enhanced by transmission electron microscopy (TEM) into ferro-eletric domains of $BaTiO_3$ single crystals [1,2,3], as well as into transitory structures within the range of phase transition [4] has had no influence on the theory of ferroelectricity, so far. The photographs of crystal surfaces and the diffraction patterns of the different ranges (Fig.1) can be sufficiently explained by the present theory of electron diffraction.
There are a couple of phenomena which accompany the electron diffraction on $BaTiO_3$ single crystals. Among those phenomena is the Tscherenkow-radiation which appears far from phase transition [5] but also very close to it [6]. Secondly, an anomalous absorption of electrons can be observed during the diffraction of electrons [7]. The classic theory does not take these effects into account. [5, 6, 7]

Another phenomenon that appears during the diffraction of electrons on $BaTiO_3$ single crystals is the formation of extra-satellites when it comes close to phase transition. (Fig. 2) These additional spots form triangles and have a distribution of intensity that is different from the main spots arising from diffraction of electrons.

We have examined the negative material with an optical stereo microscope in order to find further, more contrasted details. First of all, several perforations which look very much like holes caused by laser beams, strike the eye. [3] It seems to be characteristic that these holes often form triangles similar to those formed by satellites. (Fig.2) Holes in negative material have also been discovered in other research works [2]. It can be assumed that these extra-reflections (Fig. 2) originate from very hot charges during the exposure to electronic radiation. The perforations of the negatives are likely to stem from coherent bundles.

The intensity of such a bundle is not always sufficient for penetrating the negative material. In that event, traces of collision become visible at the surface of the negative (Fig. 4). In some particular cases (Fig. 5, 6) the central spots represent an ideal shape of a circle whereas the large circles were caused by the spreading heat during the collision.

The effects mentioned above (Fig. 3, 4, 5, 6) may be the result of cylindrical waves or of micro-particles [8]. In any case, further study of these effects might have a positive impact on the knowledge and understanding of solid state physics.

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Figure 1. Photograph of the edge of a mosaic-like crystal of $BaTiO_3$ with its diffraction pattern.

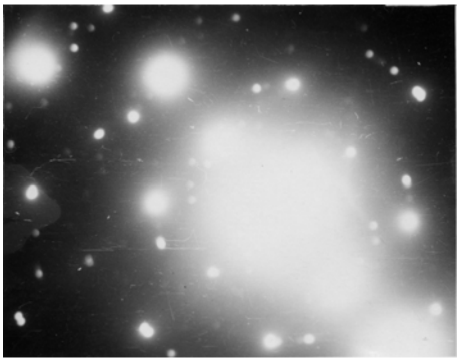

Figure 2. Diffraction pattern of a crystal near phase transition at 120° C.

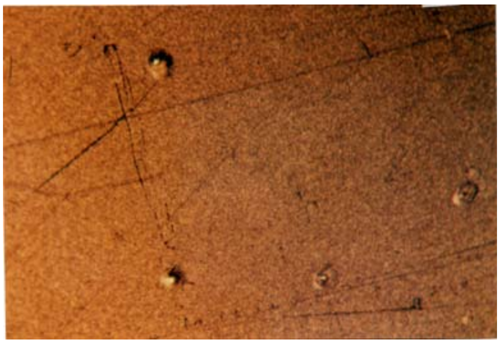

Figure 3. Shot through the negative pattern during electron diffraction on $BaTiO_3$ single crystals.

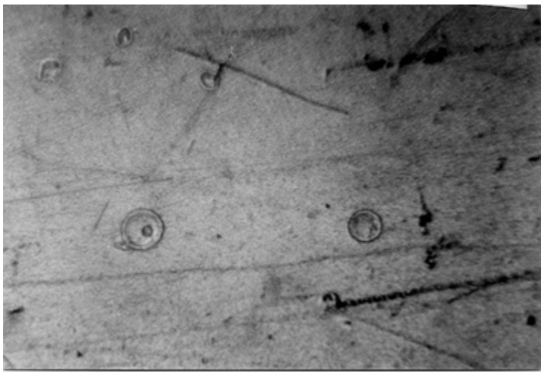

Figure 4. Traces of an impact by a cylindrical wave. The central spots in the small and the large circle are of about the same diameter.

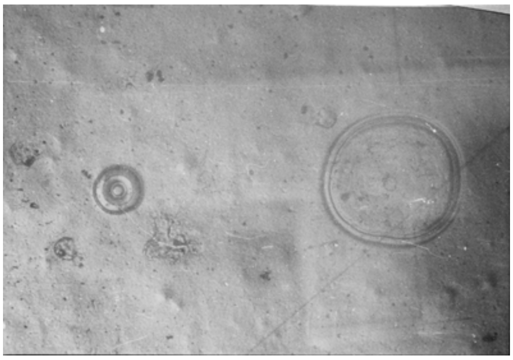

Figure 5. Further examples of collisions that accompany the electron diffraction on $BaTiO_3$ single crystals.

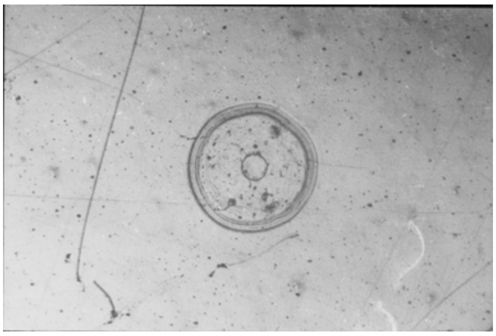

Figure 6. Magnification of one of the spots on the surface of the negative. The central circle is of an ideal shape. However, the larger circle which possibly originated from the spread of a thermal wave , due to the inhomogeneity of the negative material, does not have an ideal form.

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