Effect of Growing Condition on Defects in BBO Crystal

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Crystal of barium boric oxide (BBO) crystallizes in trigonal system. Imperfections in two specimens of (001) plates (one being transparent and the other containing inclusions) in the crystals have been identified by X-ray topography. Main defects are dislocations (including loops and helical), inclusions and electro-domains, etc. Grown-in dislocations, distributed uniformly and ranged from about 300 to 1000/cm^2 in density, usually take the forms of jogs, kinks, loops, spirals and bowed with pins on both ends. Almost all of them are decorated by impurities. Those being nearly 230μm in length and ranging normal to the plate surface exibit stronger age-effect and so movable as to disappearing. Firstly, Ba^{2+} and B-O rings are packed respectively in ABCABC sequence of the layers parallel to (001) plane and there are two adjacent anion layers of B-O rings between the cation layers in the structure. Such a compound compared with ionic one is not too ionized strongly. Secondly, crystal growth has been in flux which, in a great possibility, offers a variety of impurities to contaminate. Therefore, both structure and growth play an importat role on dislocation formation.

X-ray topographic contrast of inclusions shows two typical sets of trigonal cones with great difference both in their orientations and numbers. Major cones of one set with the conic tops towards $-c$ rotate 60° from minor ones of the other set with tops towards $+c$ axis. The results show that the inclusion formation depends not only on cation displacement of Ba, but also on the local phase transition from low temperature to high temperature forms through replacement of Ba^{2+} by Sr^{2+} or Ca^{2+}. The density of dislocation induced by inclusions is so high that they can not be resolved individually.

The electro-domains may be induced by such dislocations with high density and homogeneous distribution. Their contrast occurs in a sweet potato bed-like shape. It is worthful to note that the domain-boundaries are located nearly on one of two surfaces of plate (say $(00\bar{1})$) and related closely to the polar axis of c. Obviously, the domains are charged and movable because those domains carrying the positive charges must be easily displaced to the electronnegative regions along the polar direction, vice versa. Therefore, the structural effects on the electro-domains should also be taken into account.