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Growth macrodefects in β–BaB_2O_4 single crystals

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The study results of the growth twins and large block mosaics in BBO single crystals are presented. It has been found that the misorientation for mosaic blocks attains the following values: deviation of X-axis direction up to 2°, rotation around Z-axis, 6°. The joining of Dauphine-type macrotwins in BBO occurs along a polygonal surface with fragments perpendicular to {21.0}.

Приведены результаты исследований ростовых двойников и блоков больших размеров в монокристаллах BBO. Установлено, что для блоков разориентация достигает следующих значений: отклонение в направлении оси X — до 2°, поворот относительно оси Z — на 6°. Сращивание макродвойников дофинейского типа в BBO осуществляется по ломаной поверхности с фрагментами, перпендикулярными к {2Ī.0}.

Barium metaborate single crystals of low-temperature modification β–BaB_2O_4 (BBO) are material of good promise for higher harmonics generation of laser radiation [1]. Therefore, the requirements to the single crystal quality are very strict. That is why the investigations of different types of defects are always actual.

Twins and mosaics are referred to be the growth macrodefects in the crystals. A number of publications [2–4] is devoted to the twinning problem in BBO, but some questions remain still open. Those are connected, in particular, with the uncertainty of observations, that is, it is not clear whether mosaics, twins, or domain structure is observed. Except the mechanism proposed in [4] for twin growth and mosaics formation in BBO, all authors demonstrate the photographs only for microtwins much smaller than one millimeter. In [2], the etch figures on the BBO single crystal surface look mostly like electric domains with reversal polarity but not as twins. In this work, we present the investigation results and analysis of twin and large mosaics growth in BBO single crystals.

BBO single crystals were grown by a standard solution-melt top-seeding technique using Na_2O as a solvent. The growth direction was along Z = <0001> or X = <$2\bar{1}10$> crystallographic axis. The samples for investigations were prepared by a standard mechanical cutting and polishing technique as 2 mm thick plates. The surface orientation was x, z, and inclined to these planes. The etching was performed during 5 min in 87 % aqueous glycerol at 105 °C. The etched and unetched surfaces were investigated by means of microscope in the ordinary light at a small magnification.

As a result, we revealed the Dauphine-type macrotwins (Fig. 1) and mosaics (Fig. 2) on the etched surfaces, except microtwins similar to the represented ones in papers [2–4]. As it is seen from the Figures, the twinning joint in our case has a complex saw-like shape, thus indicating that the intergrowth surface consists of the planes with parts perpendicular to {$2\bar{1}$.0} the crystallographic axes oriented.

If a sample is cut out of the same BBO crystal with the twin having the surface is inclined to Z and X axes, the etch pattern becomes more sharply defined, and the