Abstract No. chen675

Characterization of Langatate As-Grown Crystal by Synchrotron White Beam X-ray Topography

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Beamline(s): X19C

Introduction: Langatate ($La_3Ga_{5.5}Ta_{0.5}O_{14}$ or LGT) with the $Ga_3Ga_2Ge_4O_{14}$-type structure exhibits piezoelectric properties intermediate between those of quartz and $LiNbO_3$ and $LiTaO_3$. As a promising piezoelectric material, it has temperature compensation at near room temperature, high frequency stability, adequate electromechanical coupling factors, low acoustic friction (high Q factor) and high phase transformation temperature. X-ray topography of the surface of as-grown boule enable one to observe the true microstructure developed during the crystal growth process, and is imperative for understanding the nature and distribution of imperfections.

Methods and Materials: LGT single crystal boule was grown by Czochraksi method. The curved surface of the LGT boule was examined by SWBXT with reflection geometry, shown in Figure 1. Topographs were recorded covering the entire length of the boule in longitudinal strips. After imaging of one strip of surface, the boule was rotated by a few degrees in a clockwise direction, the next strip of surface was imaged.

Results: Topographs (Figure 2.) show well-defined striations, K, perpendicular to the growth axis. Wavy contrast features, A, are caused by surface ridges running along the length of the boule. These are superimposed onto the striation images. Regions of white contrast at the tail end are probably due to the presence of precipitates, P, at the end of growth. Some precipitate type contrast is also visible in the middle sections of the boule. The several white spots and lines in the middle of the boule, C, have been created because of the presence of surface projections/depressions, such as small pits, which lead to the situation where no image is locally formation due to blockage of the diffracted beam (Figure 3). Vertical white contrast features, F, are produced in (a), (b), (c) and (d) in Figure 2 due to risers on faceted steps on the boule (the facets have (0001) orientation) which block the diffracted beam thereby causing bands of white contrast. The smooth surface produces a good quality image and clear striation contrast can be observed (Figure 4).

Conclusions: Surface X-ray topography of LGT boule was successfully carried out. Defects, such as striations and precipitates can be observed. Topographs are dominated by contrast related to surface features.

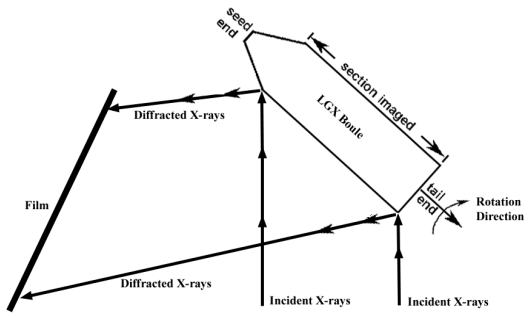

Figure 1. Schematic diagram of reflection geometry.

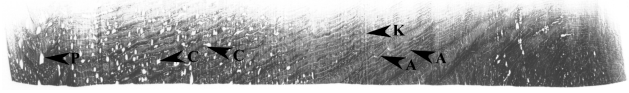

Figure 3. X-ray topograph showing striations, K, precipitates, P, wavy surface feature, A, and rough surface feature C.

Figure 4. X-ray topograph recorded from facets area showing striation, K, precipitates, P, and facets, F. In this case, striations are clearly shown in the facets

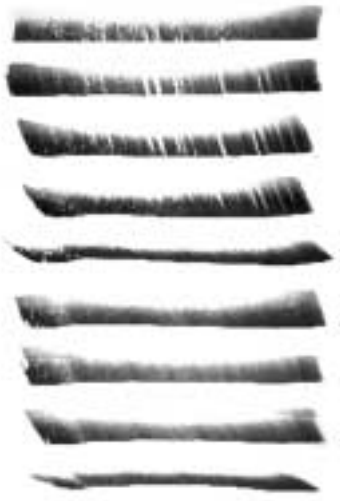

Figure 2. SWBXT images of LGT Boule recorded from reflection