THERMAL FIELD CHARACTERISATION IN THE HIGH-TEMPERATURE MELT USED FOR BBO CRYSTAL GROWTH

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β-BaB_2O_4 (BBO) single crystals are widely used in nonlinear optics; however, their growth by the Top-Seeded Solution Growth (TSSG) method requires precise control of the thermal environment. The temperature distribution inside the growth crucible plays a critical role in process stability, crystal morphology, and reproducibility. In this work, vertical and radial temperature gradients in the melt were systematically investigated under various lid configurations.

Temperature measurements were carried out using a Pt/Pt(Rh) thermocouple. The crystallisation temperature was determined by controlled cooling experiments performed at different cooling rates of 1, 3, 5, and 10 °C/h. The most reproducible crystallisation temperature was obtained at a cooling rate of 1 °C/h. Based on this result, all subsequent temperature gradient measurements were performed at a temperature 15 °C above the crystallisation temperature determined at 1 °C/h. Vertical and radial temperature gradients were investigated using different crucible lid designs with central opening diameters ranging from 8.5 mm to 35 mm. Radial temperature distributions were recorded at different heights above the crucible bottom, while the vertical temperature gradient was measured from approximately 2 cm above the melt surface down to the bottom of the melt. The influence of the lid central opening diameter on both vertical and radial temperature gradients was analysed quantitatively.

The results demonstrate that the diameter of the lid central opening has a significant effect on both the magnitude and uniformity of temperature gradients within the melt region. Larger central openings reduce radial temperature gradients but may lead to increased vertical temperature differences, whereas smaller openings promote steeper radial gradients. In addition, variations in cooling rate were shown to influence the apparent crystallisation temperature. Based on these results, optimal thermal configurations for stable and reproducible BBO crystal growth by the TSSG method are discussed.

This study provides detailed experimental insight into thermal field control and crystallisation behaviour in the solution growth melts and contributes to improved reproducibility, stability, and scalability of BBO single crystal growth.