Research Progress of Nonlinear Optical Crystal CLBO

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Lithium cesium borate ($CsLiB_6O_{10}$, CLBO) has excellent comprehensive performance, such as high laser damage threshold, small walk-off Angle, large reception Angle, larger spectrum bandwidth and temperature bandwidth. It can be used for second harmonic generation (SHG, 532nm), third harmonic generation (THG, 355nm), fourth harmonic generation (266nm), fifth harmonic generation (213nm) and difference frequency obtaining 193nm wavelength laser. It has important application prospect particularly in the field of high-power ultraviolet laser technology with fourth and fifth harmonic generation. Especially with the development of high energy density physics, CLBO has become the most excellent nonlinear optical crystal with high energy 5ω probe laser output.

The suitable growth system was determined through the study of flux system of fluoride and molybdate. The five-stage temperature-controlled furnace was used for crystal growth. Combined with theoretical simulation, an ideal temperature field was designed. Ultimately, a large-sized and low-absorption high optical quality CLBO crystal was obtained (Figure 1, 120mm× 112mm ×62mm). Based on the understanding of the mechanism of CLBO crystal moisture absorption cracking, the influence of Al^{3+} and Ga^{3+} doping on the crystal moisture resistance performance was studied and the ultraviolet moisture-proof and anti-reflection film system was explored, which promoted the practical application of CLBO in industry.

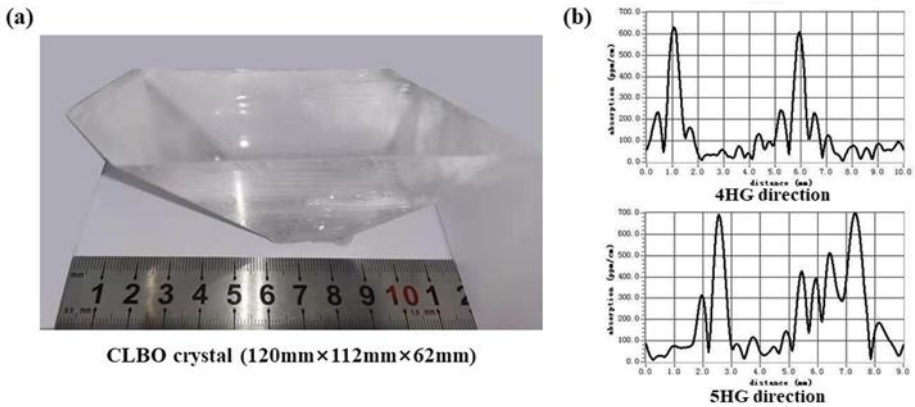

Figure 1 Large-sized and low-absorption high optical quality CLBO crystal

Overall, significant progress has been made in CLBO crystals, but challenges remain in crystal optical uniformity, UV/deep UV film coating, and device design.