Growth and properties of $Ti^{3+}:Al_2O_3$ single-crystal

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$Ti^{3+}:Al_2O_3$ single-crystal (Ti:sapphire) is a laser gain medium introduced by P. F. Moulton in 1982 [1]. Ti:sapphire emission is caused by the $^2E \rightarrow {}^2T_2$ transition of Ti^{3+} ions and is tunable in the range from 650 nm to 1100 nm where it may operate in a continuous or pulsed mode. The broad absorption band of Ti^{3+} (400-600 nm) enables wide variety of pumping such as an Ar-ion laser, frequency doubled Nd:YAG or dye lasers. Besides the usual requirements in optical quality, the figure of merit (FOM) is the crucial parameter of Ti:sapphire. Undesirable parasitic absorption in the emission region is created by a Ti^{3+} - Ti^{4+} pair inTi:sapphire [2]. FOM is defined as a ratio of absorption coefficients at pumping and emission wavelengths (usually 514 nm and 800 nm, respectively). Thus, FOM characterizes the quantity of this parasitic absorption and therefore the quality of a material.

Ti:sapphire single-crystals are produced by various methods, such as the Czochralski growth, heat exchanger (HEM), temperature gradient (TGT) or Kyropoulos methods [3-5]. Each method offers its advantages and influences final material properties. In the Crytur company, the growth of Ti:sapphire by the Czochralski method was optimized with the aim to produce small optical elements with very high quality. In this contribution, the results of Czochralski growth of Ti:sapphire will be presented and a comparison with other methods will be discussed.

References

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