Preparation of an Er^{+3}:YLF crystal for the development of a diode pumped laser emitting in the 3μm region

Cristine Calil Kores, Regiane de Souza Pinto and Niklaus Ursus Wetter
Instituto de Pesquisas Energéticas e Nucleares – Centro de Lasers e Aplicações IPEN/CLA

The interest in developing a laser based on an Er^{+3}:YLF crystal emitting in the 3 μm region is due to its potential use in medical and odontological applications [1]. Its 3 μm emission is situated at the highest absorption peak of water and therefore causes explosive evaporation of water that carries the generated heat away from the sample. The YLF is a host material widely used in solid state lasers and, as a uniaxial crystal, is naturally birefringent and therefore the resulting laser emission is intrinsically polarized [2].

The present work demonstrates the preparation and characterization of an Er^{+3}:YLF crystal with 40 mol% of erbium, for its posterior use as the active medium of a solid state laser.

The $LiYF_4$ crystal doped with 40 mol% of erbium was grown by the Czochralski method at the Centro de Lasers e Aplicações. The sample was Brewster-cut into a rectangular parallelepiped. After that, the sample was attached to a jig and went through lapping and polishing procedures. The cuts were made with a wire saw machine using silicon carbide (SiC) abrasive of mesh 600 and the solvent ethylene glycol. The lapping was done using a polishing jig on a cast iron plate with aluminum oxide abrasive of mesh 2000 as the agent and ethylene glycol as the solvent. Finally, the polishing procedure was done in an automatic polishing machine on a bee wax disc, utilizing a suspension containing 1μm aluminum oxide.

After the polishing procedure the parallelism and flatness of the sample's surfaces were analyzed by placing a reference substrate on top of the sample, illuminating it and observing the interference fringes (for each of the two surfaces of interest, corresponding to laser facets). The position of the optic axis was also analyzed by measuring the position of the Maltese Cross of the sample. The crystal had final dimensions of 4.5 mm length, 4.05 mm width and 2.35 mm height. The measure of the Maltese Cross revealed that the optic axis was perfectly aligned (within 1 degree) perpendicular to the laser propagation direction. The laser facets of size 2.35 mm x 4.5 mm showed total flatness of λ/2, over both dimensions with the central 80% of the total area being less than λ/6.

We conclude that the crystal presents the necessary qualities to work properly as an active medium of a solid state laser, and the high quality of the surfaces guarantee a minimization of losses due to geometric or superficial irregularities.

REFERENCES

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