LAPHIA
Laser & Photonics in Aquitaine

LAPHIA Seminar

Laser gain medium engineering for high energy/power laser systems:

Yb:YAG gradient doped crystals and co-sintered ceramics

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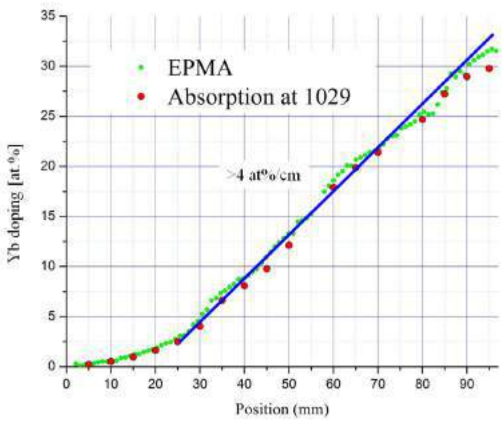
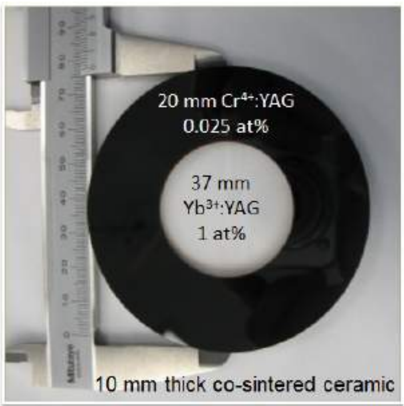
4 March, 2014 from 1 :15 pm to 2 :15 pm

Institut d'Optique d'Aquitaine – Rue François Mitterrand – 33 400 Talence

The (*Laboratoire pour l'Utilisation des lasers Intenses*) laboratory at the *Ecole Polytechnique* together with *Laserayin Tekhnika CSC* (Armenia) are experimentally exploring the growth of laser grade quality Yttrium Aluminum Garnet $Y_3Al_5O_{12}$ (YAG) crystals carrying a controlled spatial distribution of trivalent Ytterbium doping ions (Yb^{3+}). Such Laser gain media offer several advantages in laser engineering: when considering Amplified Spontaneous Emission (ASE), it helps staying always below the parasitic oscillation threshold. It also opens the way to optimized thermal load volume distribution. Gradient doped crystals have been obtained using Horizontal Direct Crystallization (HDC). This process will be detailed and the highest gradients obtained so far (4at%/cm) will be presented and commented.



This research is being performed within the framework of the Lucia program at *LULI*. The Lucia Laser is a Diode Pumped Solid State Laser (DPSSL) system using Yb:YAG as gain medium and relying on active-mirror architecture for amplification. High average power requirement (30J/10Hz goal with 14J/2Hz current achievement) makes both ASE and thermal management very critical issues. A solution is to replace homogeneously doped laser materials by variably doped ones, allowing a more efficient stored energy spatial distribution. We will show how, relying on linear gradient crystals, Lucia amplifiers performances can significantly be improved. Our calculations show that even moderate gradients (~ 2at%/cm) can lead to increased stored energy density without exceeding ASE parasitic oscillations threshold. Also, by applying controlled variation of doping, the thickness of the gain medium along the laser extraction propagation path can be reduced making more efficient the heat evacuation process.



Finally, experimental cross evaluation (wave-front, depolarization, gain) of large (77 mm diameter) Cr/Yb:YAG co-sintered ceramics and single crystals (no gradients) will be presented at 300K and 200K.

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