Contribution ID: **106** Type: **Oral (Student, In Competition) / Orale (Étudiant(e), inscrit à la compétition)**

Diode Pumped Yb:YAG Ceramic Laser Amplifier Modules for a TW Laser System

Tuesday 17 June 2014 17:00 (15 minutes)

New ceramic laser materials allow the development of scalable, high efficiency and high repetition rate direct diode pumped laser modules. We are developing a diode pumped multipass amplifier as part of a new terawatt laser system being developed at the University of Alberta. Currently measurements are being carried out of the gain and extracted energy from a Yb:YAG ceramic disk amplifier stage pumped by 3 to 6 kW of pulsed diode pump power. These measurements are being carried out both at room temperature and at cryogenic temperatures where the potential efficiency and gain of the amplifier stage is improved. The results are then compared to rate equation modeling of the pulse amplification in the amplifier stage as a function of temperature and input pulse fluence. In these calculations we have included both the effect of temperature on the cross-section values (linewidth narrowing) and also the reduced lower laser level population due to the temperature dependent Boltzmann factor. We are currently establishing the best parameters for an overall model of the amplifier stage which will allow us to predict and design the optimum pump conditions and operating temperature for a given amplifier stage. The limitations in operating conditions due to transverse ASE are also being considered in these designs. The experimental measurements and modeling calculations will be presented.

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Session Classification: (T3-4) Novel Light and Particle Sources - DAMOPC-PPD / Nouvelles sources de lumière et de particules - DPAMPC-PPD

Track Classification: Division of Atomic, Molecular and Optical Physics, Canada / Division de la physique atomique, moléculaire et photonique, Canada (DAMOPC-DPAMPC)