Modeling of Yb:YAG-based INNOSLAB ultrashort pulse amplifiers

While ytterbium-based INNOSLAB ultrashort pulse amplifiers achieve nearly diffraction-limited beam quality at powers up to the multi-kW range in fast-axis, achieving good beam quality in slow-axis needs considerable experimental optimization. In a large number of applications of high-power USP lasers, the beam must be diffraction-limited, which means optimizing this beam quality is of great importance. The slow-axis beam quality is determined by a multitude of mutually influencing effects. In order to understand and optimize the beam quality, these effects and their coupling need to be modeled.

Setup of the model

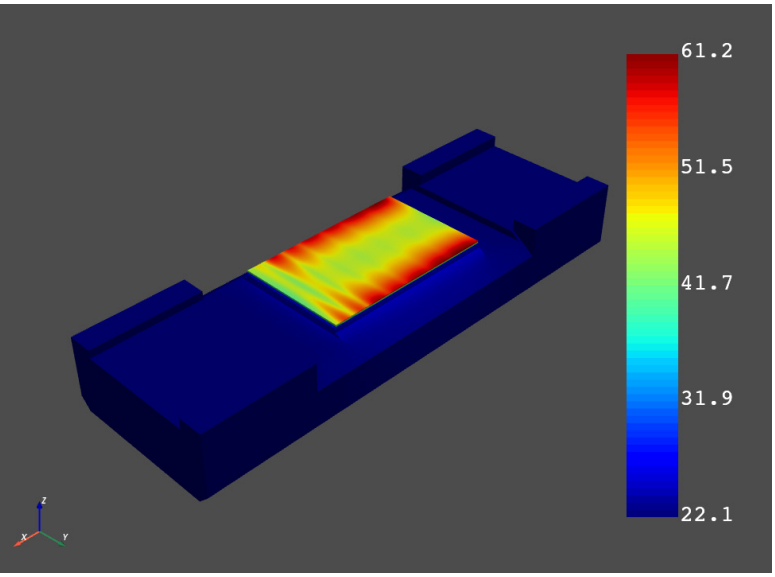
Fraunhofer ILT has developed a modular, multiphysisical model of the Yb-Innoslab amplifier, which includes pump source, amplifier beam path, crystal, heat sink with thermal interface, cooling geometry and parasitic lasing. The model has been benchmarked with experimental data on existing lasers and optimized.

Current research

For existing lasers in the 500 W class, the model provides good agreement with the experiment in terms of output power, beam quality, characteristic structures in the output beam profiles and thresholds for parasitic lasing. Ongoing research is looking at how the model can be applied to optimize beam sources under development in the multi-kW class.

Since it is modular, the model can also be adapted for modeling other laser concepts and geometries. Parts of the model are already being used in the modeling of laser sources based on gas-cooled multi-plate architectures for fusion research.

Author: Jan Schulte M. Sc., jan.schulte@ilt.fraunhofer.de



1 Simulated temperature distribution in a slab laser crystal.

Contact

Dr. Peter Rußbüldt
Group Manager Ultrafast Lasers
Phone +49 241 8906-303
peter.russbueldt@ilt.fraunhofer.de