Optimized symmetrical cooling for disk lasers

The development of a new kind of head spreader allows to control the contact surface between laser disc and head spreader. Through this invention, the big advantage of disc lasers – a better cooling of the laser material – has been improved again.

- Minimized phase disturbances
- Use of high energy materials
- Use of temperature sensitive materials
- Significant reduction of thermal stress
- Better power yield and beam quality

Application

At the Universität Stuttgart (IFSW) a disk geometry for solid-state lasers was developed, that can make powerful systems much more compact due to the considerably reduced heat load. The new system is cooled even more effectively and can now also be used with laser-active materials that previously did not work for disk configuration because of their spectroscopic properties. For any materials already in use, the pumping performance can be increased even further thanks to the new design.

Background

Stress caused by thermal expansion lead to losses in beam quality of solid-state lasers. Efficient cooling of the systems is therefore essential.

TLB

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TRL4 - Validation

Patent Situation

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15/057TLB

Service

The Technologie-Lizenz-Büro GmbH is in charge of the exploitation of this technology and assists companies in obtaining a license.

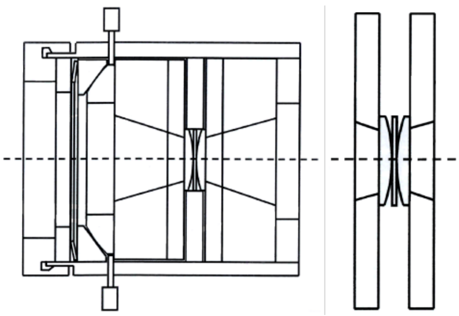
Problem

In today’s disk laser the laser disks are cooled from one side only (backside). The laser disk is glued to the heat sink. This method already leads to a very efficient cooling of the laser disk and optimizing it with the symmetrical cooling concept can make the setup even more performant and more interesting.

Solution

As primary heat spreaders, spherically curved (planoconvex) diamonds are pressed against the disk on both sides. The contact surface can be clearly defined via the purely mechanical clamping at the edge and optimized via the contact pressure. A special tilting mechanism is provided for centering the system. A further pair of heat spreaders is ring shaped and in contact to the outer area of the first one, which allows for extensive heat transfer to the cooling system.

The curvature radius of the primary elements can be adjusted so they can be used in different thicknesses but with the same efficiency. This is especially important for pulsed laser systems where you need to limit nonlinear phase shifts. Ideally, the laser is operated in transmission mode so that comparatively thin anti-reflective coatings with low thermal resistance can be used. Depolarization, which is crucial in this system, could already be compensated for efficiently and economically in another invention (see 15/058TLB).



Scheme of the overall construction (left) and enlarged representation of the core elements (right) according to the invention with laser disk (central) and heat spreader elements arranged on both sides; primary (convex) and secondary (annular). [Fig.: J.-H. Wolter, IFS, University of Stuttgart]

Publikationen und Verweise

H. Wolter, R. Balmer, S. Ricaud, M. Antier, Ch. Simon-Boisson, T. Graf, M. Abdou Ahmed, Ti:sapphire thin-disk laser symmetrically cooled by curved single crystal diamond heat spreaders, Laser Physics Letters 17/1 (2019)
https://doi.org/10.1088/ 1612-202x/ab60af