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PRECISION ASSEMBLY SYSTEM FOR LASER COMPONENTS

Task

For the assembly of optical components in solid-state lasers intended for use in space, the Fraunhofer ILT has developed and built an assembly system, and put it into operation. This system makes it possible to assemble the optics necessary for the operation of a laser by soldering and to adjust them actively. The directional and positioning tolerances that must be maintained lie in the range of 10 µrad and 10 µm, respectively.

Method

The eight motion axes of the assembly system are arranged in such a way that two special vacuum grippers on two processing heads can work simultaneously to adjust two optical components simultaneously. Since, on the one hand, the axes must travel long paths and, on the other hand, maintain high positioning precision, the processing heads are equipped with an additional precision motion system. The pre-development to this assembly system has shown that the parallel kinetic system is suitable for soldering assembly. The actual soldering is done with a specially designed gripper. This gripper is used not only to supply and hold the optics, but also to apply the electrical current needed for the resistance soldering across two electrodes at the soldering point. The system is operated in a clean room with the clean room class ISO 5.

Results

Two air-bearing linear axes allow the system to travel paths of 950 mm x 350 mm. These axes are optimized for positional stability and rigidity so that high precision can be achieved with the two parallel kinematic systems even under mechanical load. Optical elements can be positioned with step sizes of 20 nm or 1 µrad. Two optical components can be adjusted simultaneously.

Applications

The Fraunhofer ILT has successfully applied the assembly system to the optical parametric oscillator (OPO) developed for the German-French Climate Mission MERLIN. The required specifications were met thanks to the high positional accuracy and stability of the assembly system. A complex MOPA arrangement based on a Nd:YAG laser will be assembled soon.

Since the assembly system is very flexible, it can be transferred to other applications where similar stabilities and accuracies are required. For example, this is true for laser systems used in industrial environments.

Contacts

Dr. Jörn Miesner
Telephone +49 241 8906-394
joern.miesner@ilt.fraunhofer.de

Dr. Jens Löhring
Telephone +49 241 8906-673
jens.loehring@ilt.fraunhofer.de

1 Assembly system.

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
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