



SOLDERING TECHNOLOGIES SUITABLE FOR NONLINEAR OPTICAL CRYSTALS IN THE AEROSPACE INDUSTRY

Task

In particular, satellite-based laser sources for LIDAR systems require mechanically and thermally robust opto-mechanical components and they should not contain organic materials such as adhesives. Adapted solder joints are particularly suitable here. The assembly of nonlinear optical crystals such as BBO, LBO, KTP or TGG is particularly critical because of the special crystal properties and the boundary conditions occurring in use (temperature load change, mechanical shock and vibration). In addition, the differences in thermal expansion coefficients between the crystals and metallic soldering partners can adversely affect the function of the crystals due to mechanical stresses. Specifically in non-operational phases, alternating thermal loads ranging from -30°C to $+50^{\circ}\text{C}$ can compromise the mechanical strength of the crystal interface in satellite use.

Method

The nonlinear optical crystals are soldered between adapted metallic holders depending on the application and type of crystal. The geometry and the choice of materials play a crucial role. In BBO crystals, the mount is designed in the form of sheets and is elastic; it is soldered into a ceramic housing. Since LBO and KTP crystals need to be tempered in most applications, these crystals are soldered planar onto substrates adapted to heat expansion. The geometry of the holder is optimized for heat conduction. The TGG crystal is soldered into a passively cooled holder, which dissipates the heat loss at high mean power.

Results

By means of the soldered technical assembly that the Fraunhofer ILT developed for nonlinear crystals, functional modules have been built and successfully tested. For the tests, labor demonstrator models of the laser beam sources were used, which have the characteristics of the planned flight laser.

Applications

In addition to the crystals described above, the assembly technology described here can be used for other nonlinear crystal types. As well as for space applications, this method can be used for solid-state lasers in medical technology or materials processing.

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Contacts

Dipl.-Ing. Heinrich Faidel
Telephone +49 241 8906-592
heinrich.faidel@ilt.fraunhofer.de

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

1 Fully functional prototypes of soldered nonlinear crystals (from left: BBO, TGG, KTP, LBO).