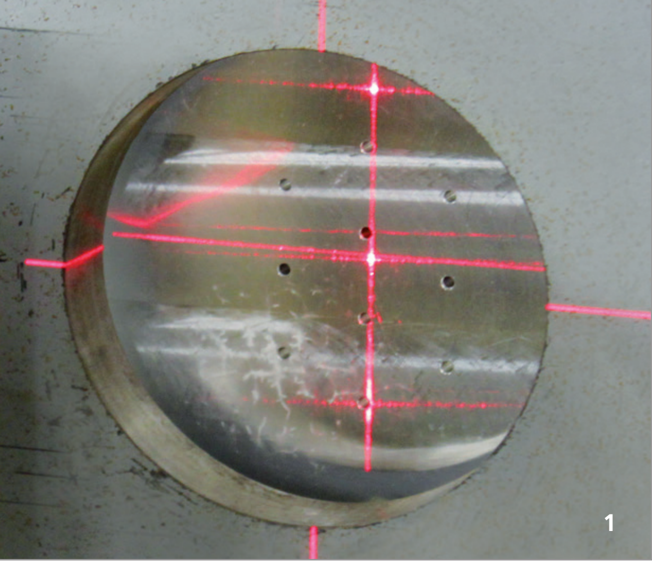

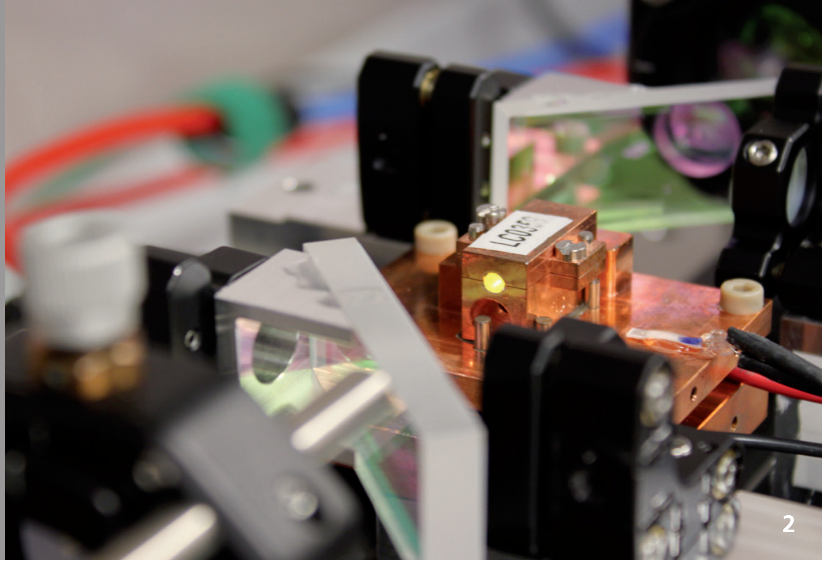

RADIATION TESTS ON TM^{3+}- AND HO^{3+}-DOPED FLUORIDE CRYSTALS

Task

Satellite-based LIDAR systems are suitable for the global and continuous measurement of CO_2 concentrations in the atmosphere. One possible design for the laser-beam source in such a system is a solid-state laser with an emission wavelength of 2051 nm based on Tm^{3+}- and Ho^{3+}-doped laser crystals of different stoichiometry. To date, however, there still have not been any published studies on these crystals regarding their radiation hardness against proton and gamma radiation.

Method

Different crystal samples from YLF and LLF with Tm^{3+}- and Ho^{3+}-doping and Ce^{3+}-codoping were irradiated with protons and gamma rays corresponding to a given mission scenario. The radiation-induced losses for the individual test items were determined in different ways: before and after radiation, transmission spectra of the specimens were measured. In addition, Fraunhofer ILT built a test laser oscillator and all of the samples were used in this oscillator as a laser medium before and after irradiation. The laser thresholds and slope efficiencies before and after irradiation were measured for each specimen and radiation-induced losses calculated from them.

Result

Radiation-induced transmission losses in the magnitude of up to 7 percent/cm for Ho^{3+}-doped and 2 percent/cm for Tm^{3+}-doped specimens were measured in the spectral range < 1000 nm at ten times the mission dose. For the nominal mission dose and in the spectral region around 2 µm, no radiation-induced losses were measured within the measurement errors (detection limit about 0.6 percent/cm). The co-doping with Ce^{3+} also promotes the radiation hardness in Ho:LLF.

Applications

The results show that Tm^{3+}- and Ho^{3+}-doped YLF and LLF crystals can be used in radiation-intensive environments. In addition to aerospace, for example, they can also be considered for use in particle accelerators.

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1 Specimen in test laser oscillator.

2 Setup for proton radiation.

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