



DIODE-PUMPED ALEXANDRITE LASER

Task

Mobile resonance LIDAR systems are being used at the Leibniz Institute of Atmospheric Physics (IAP) to measure temperature profiles of the atmosphere at altitudes between 80 and 110 km. These systems determine the Doppler width of the potassium resonance line at 770 nm and of the iron resonance line at 386 nm spectroscopically. Flashlamp-pumped alexandrite ring lasers in Q-switched single-frequency mode are used as laser emitters. Typical operational conditions include carrying out measurements on a research ship in rough seas or under polar conditions in the Antarctic. Due to harsh environmental conditions and the laser's remote operating locations, the project aims to extend maintenance-free operating times and the wall-plug efficiency. Therefore, the use of laser diodes as an alternative pump light source will be investigated at Fraunhofer ILT.

Method

A diode laser module developed at Fraunhofer ILT with emissions in the red spectral range is used to pump an alexandrite laser longitudinally. The pump radiation is linearly polarized; the depolarized power component is less than 4 percent. The pulse power is 13 W with a pulse repetition rate of 35 Hz and a beam quality factor (M^2) of 38 ± 2 and 49 ± 2 in the two spatial directions.

The alexandrite crystal used is 15 mm long and arranged in a 190 mm long laser resonator that is folded once. The temperature of the laser medium can be tuned between 30 °C and 190 °C using a thermostat.

Result

The output wavelength of the alexandrite laser in free-running mode is tunable between 755 nm and 788 nm by varying the crystal temperature. The laser achieves an optical-optical efficiency of 17.8 percent and a slope efficiency of more than 30 percent in fundamental-mode operation ($M^2 \approx 1.10$). Resonator losses are measured with the Findlay-Clay method to be around 1 percent.

Applications

The research forms the basis for developing efficient, diode-pumped fundamental-mode lasers with freely selectable wavelengths between 700 nm and 800 nm for medical and metrological applications.

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2 *Laboratory setup of the diode-pumped alexandrite laser.*