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Passively Q-Switched 914 nm Microchip Laser for LIDAR Systems

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Abstract : Passively Q-switched microchip lasers enable the great potential for sophisticated LiDAR systems due to their compact overall system design, excellent beam quality, and scalable pulse energies. However, many near-infrared solid-state lasers show emitting wavelengths > 1000 nm, which are not compatible with state-of-the-art silicon detectors. Here we demonstrate a passively Q-switched microchip laser operating at 914 nm. The microchip laser consists of a 3 mm long Nd:YVO_4 crystal as a gain medium, while Cr^{4+}:YAG with an initial transmission of 98% is used as a saturable absorber. Quasi-continuous pumping enables single pulse operation, and low duty cycles ensure low overall heat generation and power consumption. Thus, thermally induced instabilities are minimized, and operation without active cooling is possible while ambient temperature changes are compensated by adjustment of the pump laser current only. Single-emitter diode pumping at 808 nm leads to a compact overall system design and robust setup. Utilization of a microchip cavity approach ensures single-longitudinal mode operation with spectral bandwidths in the picometer regime and results in short laser pulses with pulse durations below 10 ns. Beam quality measurements reveal an almost diffraction-limited beam and enable conclusions concerning the thermal lens, which is essential to stabilize the plane-plane resonator. A 7% output coupler transmissivity is used to generate pulses with energies in the microjoule regime and peak powers of more than 600 W. Long-term pulse duration, pulse energy, central wavelength, and spectral bandwidth measurements emphasize the excellent system stability and facilitate the utilization of this laser in the context of a LiDAR system.

Keywords : diode-pumping, LiDAR system, microchip laser, Nd:YVO4 laser, passively Q-switched
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