High Energy and High Power Single Frequency 1572 nm Laser With an All-Fiber MOPA

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Abstract:
A high pulse energy and high power all-fiber-optic single frequency laser at 1572 nm has been demonstrated and delivered for CO2 LIDAR applications. The main amplifier is made with the company's proprietary large mode area highly erbium-doped silicate glass fiber with a core diameter of 50 μ m. The pump laser is a high power 1480 nm Raman fiber laser. A maximum pulse energy of 2.2 mJ has been achieved at 2.5 kHz pulse repetition rate with diffraction limited beam quality, which is the highest pulse energy and average power combination for an all-fiber based laser at 1572 nm to the best of our knowledge. For purpose of extended lifetime and consistent performance, the output pulse energy from the delivered unit was limited to 1.8 mJ with a pulse duration of ~600 ns, corresponding to a peak power of ~3.0 kW.

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Contents

High pulse energy and high peak power single frequency lasers are highly desirable for many applications, like remote sensing, frequency conversion and coherent LIDAR. Accurate measurements of tropospheric CO2 concentrations are crucial to understand the global carbon cycle. One of the major CO2 absorption lines is located near 1572.3 nm. Using a pulsed single frequency laser at 1572 nm, NASA demonstrated airborne CO2 column absorption measurements with the integrated path differential absorption (IPDA) technique [1]. The airborne campaign was a technology demonstration in preparation for the ASCENDS (Active Sensing of CO_2 Emissions over Nights, Days, and Seasons) mission in which a high energy, rugged, reliable, polarization maintaining (PM) and narrow linewidth 1572 nm laser is a requirement. With the advantages of compactness, robustness, excellent beam quality, and intrinsic freedom from maintenance, single frequency erbium- (Er-) doped fiber lasers are one of the best choices for such an airborne application. However, due to the strong confinement and long geometry, nanosecond fiber laser peak power is limited by nonlinear effects, like stimulated Brillouin scattering (SBS). In addition, 1572 nm is detuned from the gain peak of the Er-doped fiber. The amplified spontaneous emission (ASE) and parasitic lasing at shorter wavelengths set limitations for Er-doped fiber amplifiers operating at 1572 nm.

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