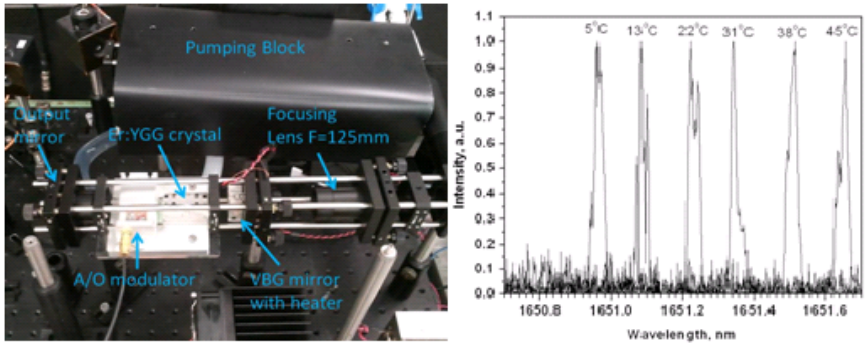
NASA SBIR/STTR Technologies

S1.01-8389 - Efficient in-band diode-pumped Q-switched solid state laser for methane detection

PI: Igor Kudryashov
Princeton Lightwave, Inc. - Cranbury, NJ

Identification and Significance of Innovation

We propose to develop an efficient, tunable Q-switched SSL operating at a wavelength of 1651 nm with pulse energy >1 mJ at 2000 Hz repetition rate with in-band laser diode pumping. We will leverage initial work carried out during Phase I of this program to pursue two approaches: (i) a tunable injection-seeded Q-switched SSL, and (ii) a regenerative power amplifier. In Phase I, we investigated a variety of gallium garnet gain media?including comprehensive characterization of absorption and fluorescence spectra?and we have identified the most promising prospective crystals for 1651 nm emission. We have also demonstrated sufficient tunability to enable differential path LIDAR techniques for the detection of methane.



Photograph of Er-doped gallium garnet SSL prototype [left] and demonstration of tunable emission near 1651 nm [right].

Estimated TRL at beginning and end of contract: (Begin: 3 End: 4)

Technical Objectives and Work Plan

I. Develop of an efficient and robust gain block for a tunable 1651 nm SSL with 1468 nm spectrally narrowed pumping.
II. Demonstrate an injection-seeded Q-switch SSL architecture at 1651 nm using Objective I gain block with >1mJ in 40 ns pulses
III. Demonstrate an efficient regenerative power amplifier at 1651 nm with up to 1 mJ pulses and <5 ns pulse width
TASK A: Develop gain block module * Task A.1 Fabrication of effective laser diodes operating at 1468nm and optimized for pump modules *Task A.2 Design and assemble pump modules * Task A.3 Design and assemble gain blocks * Task A.4 Test gain block module
TASK B: Develop an injection-seeded Q-switch laser * Task B.1 Design and assemble SSL * Task B.2 Test SSL * Task B.3 Improve SSL design
TASK C: Develop an regenerative power amplifier for pulses <5ns * Task C.1 Design and assemble power amplifier version for pulse energy <10uJ * Task C.2 Test power amplifier version for pulse energy <10uJ * Task C.3 Design bulk element for delay of high energy pulses * Task C.4 Design and assemble power amplifier version for pulse energy >1mJ * Task C.5 Test SSL version for pulse energy >1mJ

NASA Applications

+ LIDAR instruments intended for the measurement of methane in the Earth's atmosphere
+ Active remote sensing optical instruments (lidar)

Non-NASA Applications

Remote gas sensing
+ Range-finding and ladar applications
+ Commercial lidar systems
+ Medical systems
+ Material processing

Firm Contacts

Igor Kudryashov
Princeton Lightwave, Inc.
2555 Route 130 South, Suite 1
Cranbury, NJ, 08512-3509
PHONE: (609) 495-2600

NON-PROPRIETARY DATA