

# High-efficiency oscillations at 1940 nm and 2070 nm in diode-pumped Tm:Lu<sub>2</sub>O<sub>3</sub> ceramics lasers and their OPO frequency conversion

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**Abstract** — CW and repetitively-pulsed oscillations at 1940 nm or 2070 nm in diode-pumped Tm:Lu<sub>2</sub>O<sub>3</sub> ceramics lasers were studied and optimized. Mid-IR optical parametric oscillators based on AgGaSe or ZnGeP nonlinear crystals pumped by the Tm:Lu<sub>2</sub>O<sub>3</sub> laser radiation were examined.

**Keywords** — Laser ceramics, repetitively pulsed oscillations, optical parametric oscillators, mid-infrared band

Solid-state 2- $\mu$ m lasers based on Tm- or Ho-doped crystals and glasses having many applications for surgery, material processing, lidars, gas detection, and pumping of mid-IR optical parametric oscillators (OPOs) are attracting great interest in the last years [1]. High-quality laser ceramics are investigated as a substitute for the single crystals. Recently, the sesquioxides Lu<sub>2</sub>O<sub>3</sub> ceramics doped by Tm<sup>3+</sup> ions have demonstrated good potential for the efficient laser oscillations in CW and repetitively pulsed (mode-locking or Q-switched) regimes [2-5].

In this report, we present the recent results of investigations of the diode-pumped Tm:Lu<sub>2</sub>O<sub>3</sub> ceramics lasers. The Tm:Lu<sub>2</sub>O<sub>3</sub> ceramics under diode pumping at  $\sim$ 800 nm were found to be able to oscillate both at around 2070 nm and 1940 nm. CW and Q-switched oscillations regimes in these lasers were studied and optimized. Acousto-optical modulators were used to provide powerful repetitively-pulsed radiation at these wavelengths.

The nonlinear frequency conversion of the 2- $\mu$ m radiation of the Tm:Lu<sub>2</sub>O<sub>3</sub> lasers was examined. The OPOs based on AgGaSe or ZnGeP nonlinear crystals pumped by the Tm:Lu<sub>2</sub>O<sub>3</sub> lasers were created. The mid-IR radiation at wavelengths of 3-5  $\mu$ m was obtained.

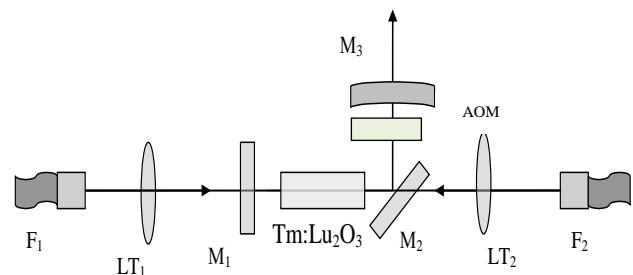


Fig. 1. Experimental schematic of the double-side pumped Tm:Lu<sub>2</sub>O<sub>3</sub> ceramics lasers. F<sub>1</sub> and F<sub>2</sub> are the fiber-coupled diodes, LT<sub>1</sub> and LT<sub>2</sub> are telescopes, M<sub>1</sub>-M<sub>3</sub> are the cavity mirrors, AOM is the acousto-optical modulator.

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