High Efficiency In-Band Pumped Tm- and Ho-Doped 2-μm Solid-State Lasers

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The expansion of laser sources operating at 2-3 μm is motivated in large by strong absorption in atmospheric gases, liquid water, and plastics, critical for applications in remote sensing, soft and hard tissue surgery, and materials processing. 2-μm novel solid-state lasers based on Tm^{3+}-doped ceramics (Lu_2O_3 or Y_2O_3) or YAP crystals in-band pumped by a fiber laser at 1670 nm are presented in this report. CW, actively or passively Q-switch operations of the Tm^{3+}-doped lasers were investigated. The Tm^{3+} laser characteristics were compared with parameters of an in-band fiber-laser-pumped Ho^{3+}:YAG laser. The 2-μm output of the lasers was used to pump the Cr^{2+}-doped ZnSe or CdSe crystals. The C^{2+}:ZnSe laser output was tuned between 2.3 and 2.7 μm. The tuning range of the Cr^{2+}:CdSe laser was from 2.5 to 3.15 μm. The lasers based on the Tm^{3+}:Lu_2O_3 ceramics and the Tm^{3+}:YAP crystal were also used as pump sources for mid-IR optical parametric oscillators (OPOs) or second-harmonic generators (SHGs). The high-efficiency oscillations were obtained at 3.8-4.1 μm in the OPOs based on a fun-out PPMg:LN; the SHGs provided the repetitively-pulsed radiations at 970-983 nm.