# Green and yellow laser performance of Tb:$LiYF_4$ and $LiTbF_4$

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$Tb^{3+}$-lasers can emit directly in the visible spectral region via blue-emitting semiconductor pumping. Compared to the conventional frequency-converted visible lasers, the cavity design is simple and the energy losses during the frequency-conversion operation are circumvented. Moreover, $Tb^{3+}$ is able to provide yellow laser emissions which are difficult to be obtained via conventional frequency-converted lasers.

Herein, we report the laser performance of the 15%Tb:$LiYF_4$ (Tb:YLF) and $LiTbF_4$ (TLF) crystals at around 544 nm and 582 nm. The pump source used for the laser experiments was a frequency-doubled optically pumped semiconductor laser emitting at 488.0 nm, which overlaps with the $^7F_6 \rightarrow {}^5D_4$ GSA transition. The single-pass absorption efficiency of Tb:YLF and TLF were measured to be 54% and 62% at the pump wavelength, respectively.

The green laser performance of Tb:YLF in a typical plano-concave cavity is presented in Fig. 1(a). A maximum output power of 1.17 W at 544 nm could be obtained at 2% $T_{oc}$ ($\eta_{slope}$ = 59%, $P_{thres.}$ = 155 mW). The optical-to-optical efficiency in terms of absorbed power of this laser was as high as 55%. We also succeeded in lasing at 582 nm with Tb:YLF for the first time. The $\sigma_{em}$ at 582 nm is ca. a factor of 4 lower than that at 544 nm. This leads to a lower slope efficiency of 21% and a high laser threshold of 970 mW for the yellow laser (2% $T_{oc}$). The green laser experiments of TLF were carried out in similar conditions to Tb:YLF. However, noticeable thermal roll-over of the output power was observed in TLF under cw pumping (Fig.1 (b)). This is because of the lower thermal conductivity of TLF. A slope efficiency of 45% was obtained under q-cw pumping (10% duty cycle). We believe that this problem can be solved by allowing active cooling and that TLF is a promising material for producing high-power q-switched lasers.

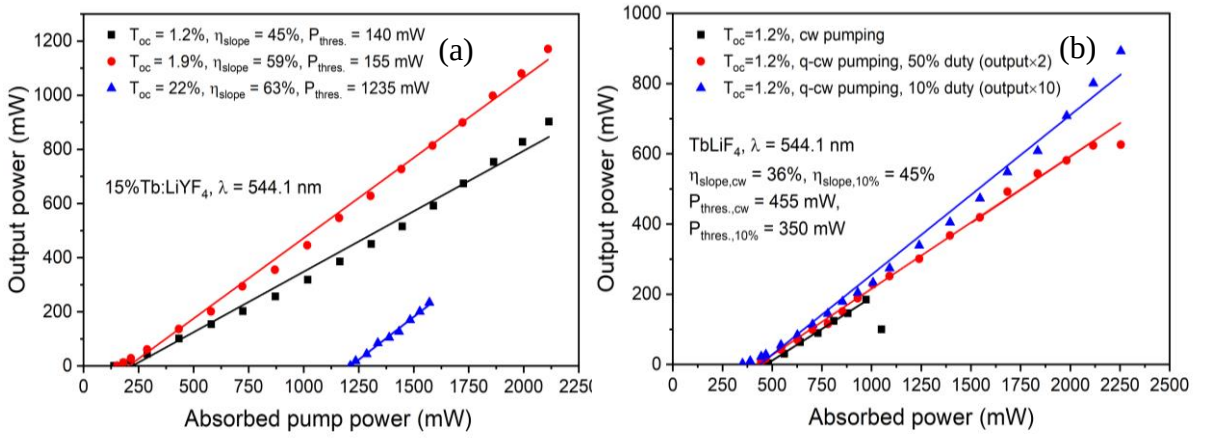


Fig. 1. Laser output characteristics of (a) Tb:YLF and (b) TLF at 544 nm.