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Abstract

We propose an efficient concept increasing the power of diode laser systems in the visible spectral range. In comparison with second harmonic generation of single emitters, spectral beam combining with subsequent sum-frequency generation enhances the available power significantly. Combining two 1060 nm tapered diode lasers, we achieve a 2.5-3.2 fold increase of green light with a maximum power of 3.9 Watts in a diffraction-limited beam. At this level, diode lasers have a high application potential, for example, within the biomedical field. In order to enhance the power even further, our concept can be expanded combining multiple diode lasers.

Summery

Efficient and compact green lasers are of high importance for many applications. Unfortunately, the green power achieved with diode lasers is limited by thermal degradation and beam filamentation at high currents. Therefore the question remains how diode lasers could provide mid-power range, diffraction-limited green light, as required for many biomedical applications?

We propose an efficient concept increasing the power of diode laser systems in the visible spectral range. In comparison with second harmonic generation of single emitters, we show that spectral beam combining with subsequent sum-frequency generation enhances the available power significantly. Combining two 1060 nm distributed Bragg reflector tapered diode lasers ($M^2_{4\sigma} \leq 5.2$), we achieve a 2.5-3.2 fold increase of green light with a maximum power of 3.9 Watts in a diffraction-limited beam ($M^2_{4\sigma} \leq 1.3$). Without any further stabilization the obtained power stability is within ± 2.6 %. The electro-optical and nonlinear conversion efficiencies are 5.7 % and 2.6 %/W, respectively. Due to the intrinsic wavelength stabilization of the diodes we achieve single-mode emission with a side-mode suppression > 15 dB and a spectral width as narrow as 5 pm.

These results increase the application potential of green diode laser systems, for example, within the biomedical field. In order to enhance the power even further, our proposed concept can be expanded combining multiple diode lasers.