>30 MW Peak Power Distributed Face Cooling (DFC) Handheld Laser

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Recent progress of Giant Micro-Photonics toward ubiquitous power laser provides giant power with fruitful applications in the fields of laser ignition, Master Oscillator Power Amplifier, and laser material process such as laser peening, new material creation under intense shock wave [1]. The development of high-power and high field solid-state laser is limited by heat from gain media during laser operation. End-pumped Distributed Face Cooling (DFC) laser with monolithic multi-disks structure combines both the advantages of conventional rod laser and thin-disk laser such as high gain cross section and compact heat-distraction structure. A new architecture of DFC gain media is proposed here through fabricating monolithic multi-disks by Surface Activated Bonding (SAB) technology. Four sets of uncoated Nd^{3+}:YAG single crystal with gain aperture of 8mm×8mm and thickness of 1mm was used. Five sets of transparent sapphire single crystal with aperture of 10mm×10mm and thickness of 1 mm was used as heat sink media [2].

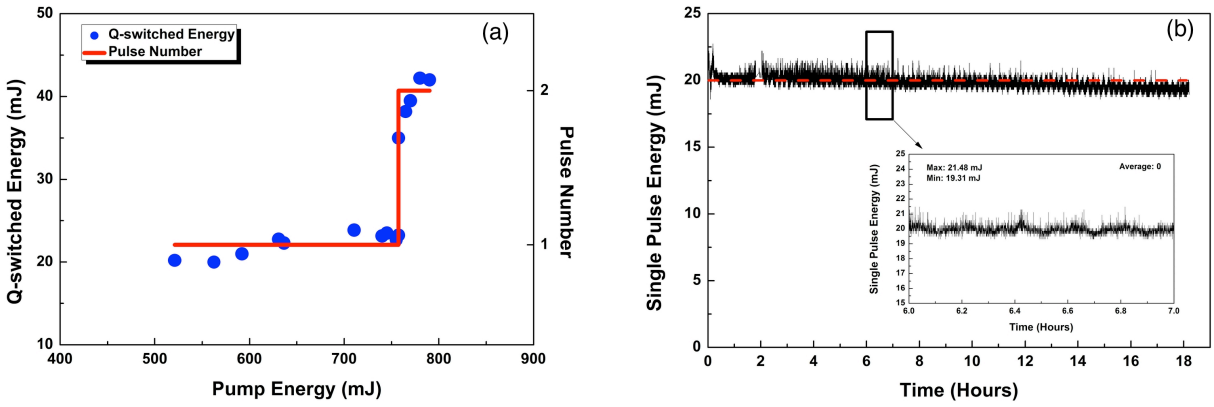

Fig. 1. Burst modes from DFC laser

Figure 1(a) shows the 1064 nm Q-switched energy and pulse numbers under different pump energy. Figure 1(b) demonstrates the stability test for 18 hours under pump peak power of 1450 W and pump pulse duration of 251 μs at 10 Hz. The brightness $B = P/(\lambda^2 \times M_x^2 \times M_y^2)$ was 20.76 TW·cm^{-2}·sr^{-1}. Brightness temperature $T_B = P \times \lambda_1 \times \lambda_2 / (M_x^2 \times M_y^2 \times \kappa_B \times c \times \Delta\lambda)$ reached 3.35 EK. The brightness temperature of sun is 6000 K. In conclusion, a sub-nanosecond DFC handheld laser has been demonstrated with pulse energy of 21 mJ, pulse width of 666 ps, peak power of 31.5 MW, depolarization ratio of 1.56% and brightness over 20 TW·cm^{-2}·sr^{-1} at 10Hz. The authors acknowledge the support from ImPACT.

References

[1]. Lihe Zheng, Arvydas Kausas, and Takunori Taira, Opt. Express 24, 28748-28760 (2016)

[2]. Lihe Zheng, Arvydas Kausas, and Takunori Taira, Opt. Mater. Express 7, 3214-3221 (2017).