Efficient Er:YAP laser with 5.3 W of output power at 2920 nm

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High power mid-infrared lasers at 3 μm are attractive for remote sensing and laser medicine, as well as generating the longer wavelength via pumping the Fe^{2+} and Dy^{3+} doped laser materials, or the nonlinear frequency conversation. LD (~980 nm) pumped Er-doped materials, such as garnet crystals (YAG) [1], oxide (Y_2O_3, Lu_2O_3) [2] have been widely studied and have been proved to be efficient methods to generate the 3 μm emission. In these cases, high doping concentration of Er^{3+} is necessary to increase the ETU process in the laser system hence to reach the population inversion, but on the other hand, resulting in serious thermal effects in the crystal. In order to increase the laser efficiency and meanwhile, reduce the risk of crystal damage, a laser material with low phonon energy, high conductivity and high thermal shock parameter is favorable. Er:YAP crystal has a lower phonon energy, high conductivity and thermal shock parameters, making it an excellent candidate for high power operation at 3 μm. In this work, an 976 nm LD pumped high-power Er:YAP laser is demonstrated. A maximum output power of 5.3 W was obtained with a slope efficiency of 29%. To the best of our knowledge, this is the highest output power generated from an Er:YAP laser.

Figure 1 shows the output power as a function of the absorbed pump power. Lasing begins to start at ~0.8 W of absorbed pump power. At ~2 W of output power, laser wavelength was measured to be 2920 nm. At the maximum absorbed pump power of 20.3 W, an output power of 5.3 W was obtained. The output power shows linear relationship with increasing the pump power, with a slope efficiency as high as 29%. In addition, our calculation shows that the current absorbed pump power is far from the crystal damage threshold, meaning that there is still room for further improvement in output power. Meanwhile, good heat management is necessary since there is a high heat generation parameter (~67%) from quantum defect in this system.

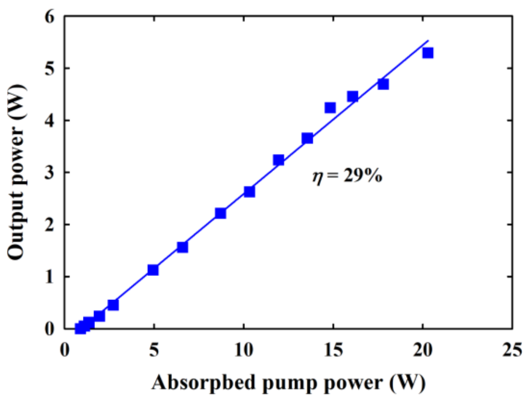

Fig. 1. Output power as a function of absorbed pump power.

References

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