Nd:YAGセラミックマイクロチップによる25MW尖頭値ドーナツモード受動Qスイッチレーザー

Passively Q-switched 25 MW peak power doughnut mode laser using Nd:YAG ceramic microchip

分子研[1]，理化学研 SPring-8[2] ○(P)林 桓弘[1]，(P)平等 拓範[1,2]

IMS[1], RIKEN SPring-8[2] ○Hwan Hong Lim[1], Takunori Taira[1,2]

E-mail: lim-hwanhong@ims.ac.jp, taira@spring8.or.jp

Because unstable cavity allows usually a wide and controllable mode size in doughnut mode, it is suitable for power scale-up. It could keep a constant beam quality due to the uniform beam shape while the beam quality of stable cavity can be degraded by additional higher modes for a wider mode. Therefore unstable cavity can be an alternative for a high brightness laser [$\propto P/(M^2)^2$]. On the other hand, sub-ns microchip lasers have realized and improved the research fields such as laser ignition, an optimum air breakdown, high power THz generation. Therefore, we combined microchip laser and unstable cavity for a high brightness laser with a sub-ns pulse. The cavity design was based on the positive branch confocal resonator where the mirror radii of curvatures are determined by choosing the empty cavity length and the magnification, which is the ratio of the mode diameter to output mirror diameter. However, we first tested and confirmed a stable laser oscillation at 10 Hz repetition rate with a flat back cavity mirror and an output mirror which has a 2 mm diameter high reflection spot mirror on the center part of the convex surface of a plano-convex lens (OPTOQUEST). Figure 1(a) shows the schematic diagram of experimental setup. A monolithic Nd:YAG/Cr:YAG ceramic (Konoshima Chemical) with a structure of 6×6×7 mm^3 was used for gain medium and passive Q-switch. Figure 1(b) shows the measured doughnut beam pattern and pulse shape for the pulse width of 520 ps at FWHM. Figure 1(c) shows the stability of the pulse energy in a short term of 5 minutes. The pulse energy was over 13 mJ for the pump energy of about 160 mJ. The root mean square (RMS) stability was as small as 1%. In a conclusion, a stable, compact, and 25 MW peak power doughnut beam laser was demonstrated using a ceramic microchip laser with unstable cavity. This work was supported by ImPACT Program of CSTI.

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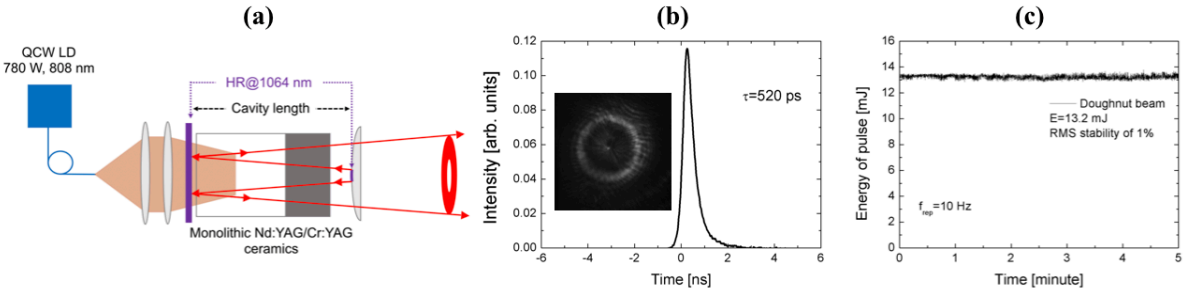

Fig. 1. (a) Schematic diagram of experimental setup. (b) Measured beam pattern and pulse shape. (c) Measured pulse energy during a short term of 5 minutes.