Giant-Pulse Width Tunable System based on Composite Nd:YAG/Cr:YAG Ceramic Microchip Laser

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Laser ignition for internal combustion engines promises greater fuel efficiency and less pollution because it allows 1) multi-point ignition, 2) multi-pulse ignition, 3) high energy ignition, 4) flexible position ignition. Giant pulse microchip ceramic lasers have been a solution for laser ignition due to its > MW peak power, very compact structure, stability, and low cost [1-3]. The world first microchip laser ignited gasoline engine vehicle was recently operated [4]. In order to investigate the pulse width dependence of the minimum energy for laser induced breakdowns, we developed a giant-pulse width tunable laser by cavity length control. It also can be useful for the study of pulse width dependence in laser induced breakdown spectroscopy (LIBS) and optics damage. A monolithic ceramic of Nd(1.1%):YAG and Cr^{4+}:YAG (L=7 mm) was used for the gain medium and passive Q-switch. A fiber coupled QCW diode laser (808 nm, 60 mJ, 100 Hz) was used for the end-pump source. An output coupler (R=50%) was used and adjusted for pulse width tuning. The wide pulse width tuning range from 0.5 to 9.3 ns was achieved by increasing the cavity length from 14 to 270 mm (Fig. 1). The whole pulses had high peak powers over 0.5 MW up to 6 MW (Fig. 2). The characteristics of the pulse width tunable laser and the pulse width dependent minimum air-breakdown energy will be presented in detail. The authors thank Dr. M. Tsunekane of Canare Electric Co., Ltd. for the contribution to laser system development. This work was partly supported by NEDO.

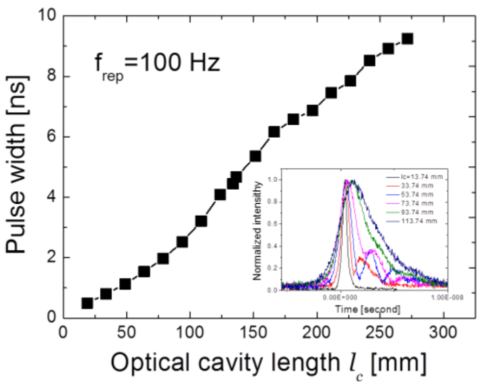

Fig. 1. Pulse width versus optical cavity length.
Inset: typical pulse shapes.

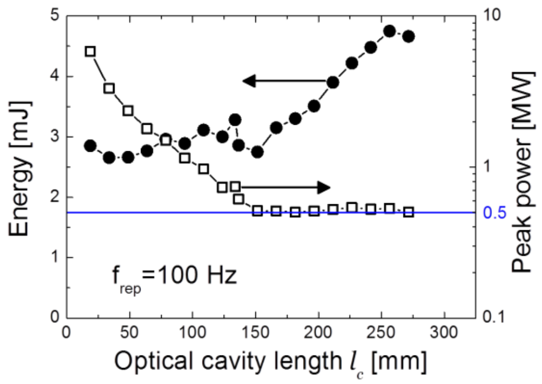

Fig. 2. Pulse energy and peak power versus
optical cavity length.

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