MULTIPLE-BEAM OUTPUT HIGH-PEAK POWER Nd:YAG/Cr^{4+}:YAG LASER FOR LASER IGNITION

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Alternative propellant combinations for orbital manoeuvring system and reaction-control system require new ignition devices for a new generation of thrusters. Such thrusters need to withstand large, from hundred to thousand range, number of cycles. Additional requirements are concerning the replacement of the toxic propellants with green ones. The classical methods of ignition are based on pyrotechnical and electrical effects. Recently, a lot of efforts are made to develop an alternative ignition technology based on solid-state lasers [1]. The energy required for a reliable ignition depends on the working conditions and one alternative to single high-energy laser pulse is a multiple-pulse laser system that allows the focusing of several pulses in a small volume. Single and multipoint ignition [2-5] has been also studied for car engine ignition.

In this work we are reporting on the realization of a compact laser that delivers four independent output beams. The device, shown in Fig. 1a, is made of a composite Nd:YAG/Cr^{4+}:YAG structure. Monolithically resonator was obtained by coating the high-reflectivity mirror on Nd:YAG input side and the out-coupling mirror on the exit surface of Cr^{4+}:YAG.

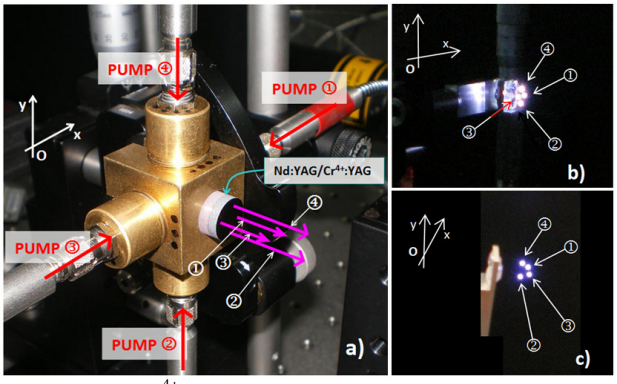

Fig. 1. a) A photo of the Nd:YAG/Cr^{4+}:YAG laser with four-beam output is shown. Each laser beam can be focused **b)** in the same plane, at equal distances from the optics or **c)** in different points.

The pump was made by four fiber-coupled diode lasers (Jenoptik, Germany) in quasi-continuous wave regime. A simple optical system was designed in order to transfer the pump radiation into Nd:YAG/Cr^{4+}:YAG, keeping the compactness of the device and assuring mm-order distance between each laser beam. The laser pulse energy for each beam was up to 5 mJ with duration below 1 ns. The four beams were focused such as to obtain plasma in points placed in the same plane (Fig. 1b) or in points chosen in different planes (Fig. 1c), in order to access a large volume of the inflammable mixture. This laser device could be used for multiple-point ignition in automobile car engine, natural-gas stationary engines, or orbital manoeuvring thrusters.

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