DIODE-PUMPED LASER RESEARCH

by

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The Laboratory for Oceans is currently working on the development of compact laser diode array (LD) pumped Nd:YAG lasers for use in space-based altimetry and ranging. Laser diode-array pumping technology promises to increase the electrical to optical efficiency of solid state lasers by an order of magnitude with a lifetime increase of nearly three orders of magnitude relative to today's conventional flashlamp-pumped laser systems. The small size, efficiency, and ruggedness make LD-pumped solid state lasers ideal for space based applications.

Under SBIR Phase I & II, OSSA RTOP, and OAST RTOP funding, LD-pumped, Q-switched Nd:YAG lasers are being developed by Lightwave Electronics of Mountain View, California. In an in-house RTOP effort, Ken Chan has designed and is currently testing, a novel multiple-pass LD-pumped Nd:YAG laser amplifier[1] to increase the 100 uJ output pulse energy of the Lightwave laser oscillator (Figure 1). Preliminary results have yielded a round trip amplifier gain of about 15% using 7 mJ LD-pump energy. This amplifier gain is mainly limited by the amount of LD pumping energy available and should increase when two new 10 mJ laser diode pump arrays replace the current ones. Analytical results indicate that with, for example, 40 mJ pump energy, a 4-pass Nd:YAG amplifier could amplify the 100 uJ pulse energy to about 6 mJ. A Q-switched oscillator with more than a few 100 uJ output

energy[2], in combination with the multiple-pass amplifier, should become a practical laser source for remote sensing applications.

As a parallel activity, DDF funding has been recently obtained to investigate the possible use of custom made fiber optic arrays to obtain an efficient optical coupling mechanism between the emitting laser diode-arrays and the target solid state laser material. Fiber optic coupling arrays would allow for the easy manipulation of the spatial emitting pattern of the diode pump sources to match either an end or side pumping laser configuration. For example, a 1 cm by 1 um typical emitting area from a laser diode-array could be coupled into a linear fiber array that terminates in a 1.8 mm diameter circle; an ideal termination for end pumping of laser rods (Figure 2). Use of fiber optic coupling arrays could also allow for the efficient multiplexing of pump sources acting on a given laser rod by isolating the sensitive and bulky laser diodes from the laser rod. This summer both research activities will be merged to demonstrate a laser diode-array pumped, fiber optic coupled Nd:YAG oscillator and amplifier system.

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[1]Chan, K. "Multiple-Pass Laser-Diode-Pumped Nd:YAG Amplifier: Design," Applied Optics, 26, 3177 (1987).

[2]Chan, K. "Generation of High-Power Nanosecond Pulses from Laser Diode Pumped Nd:YAG Lasers," Applied Optics, 27, (1988).

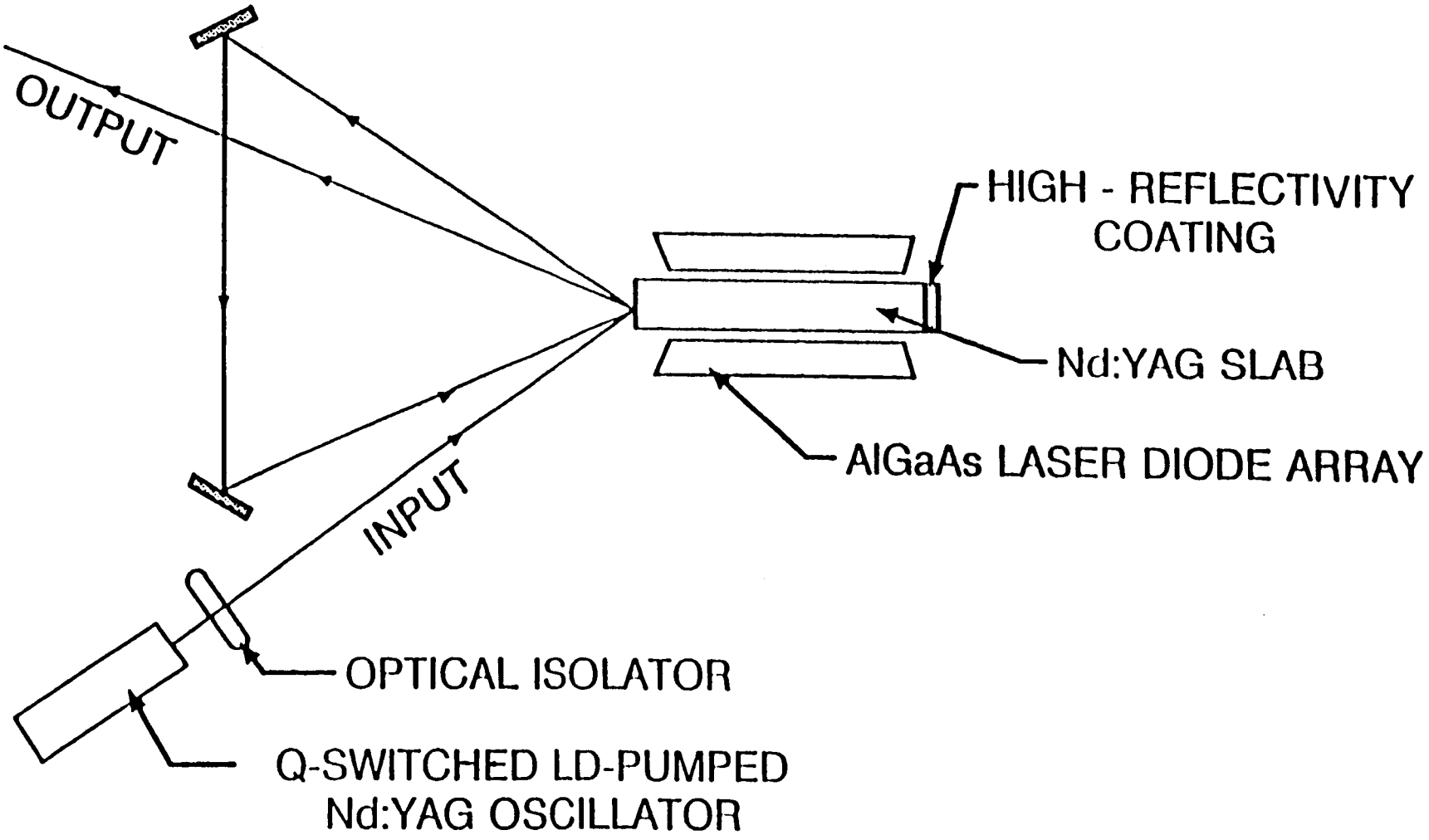

Figure 1. Laser Diode - Pumped Nd:YAG Amplifier

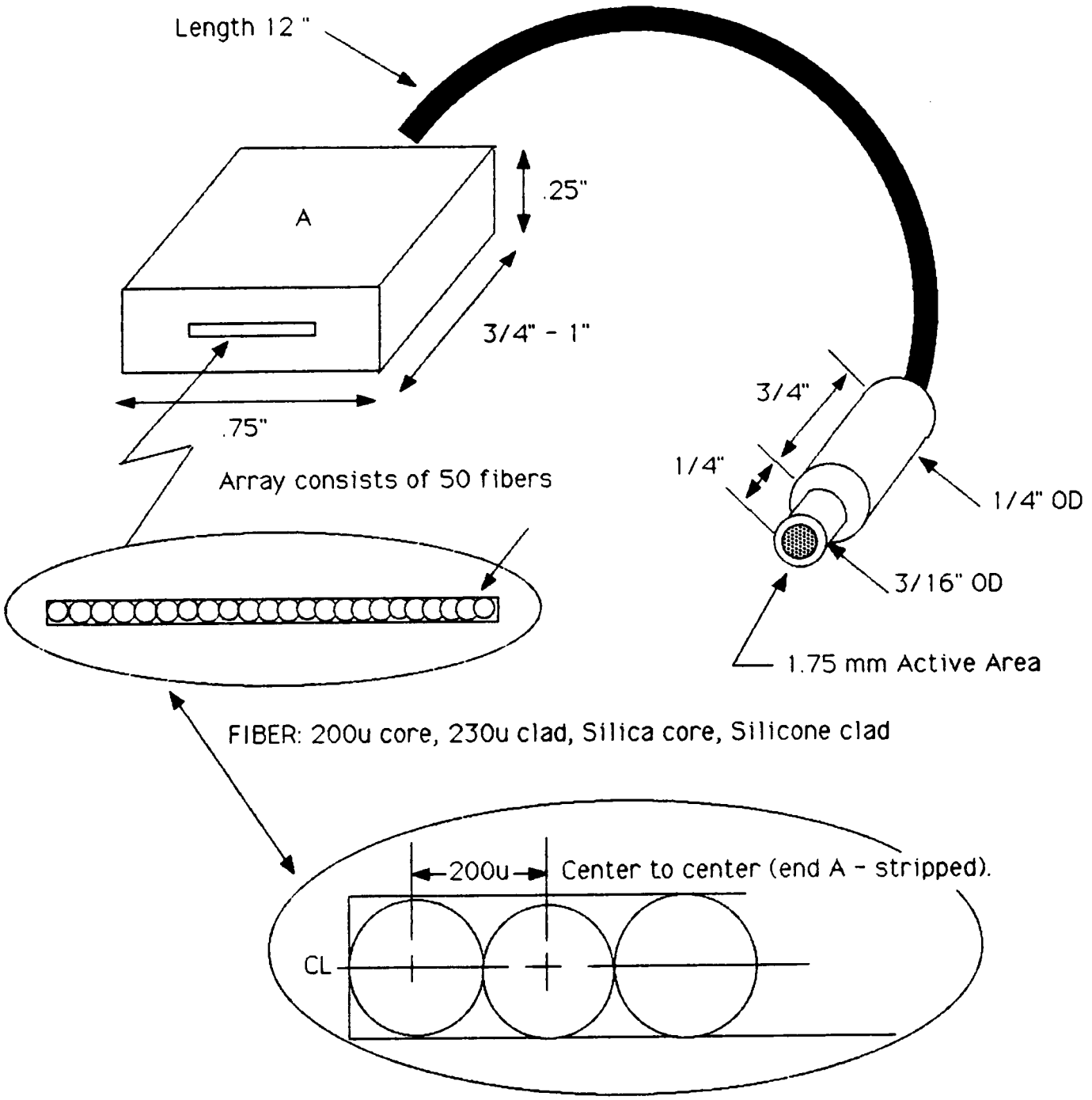

Figure 2. Fiber-Optical Coupling Array