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ABSTRACT TITLE:
Laser-welded Packaging of a Nd:YAG Laser with Redundant Pumping

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ABSTRACT TEXT:
The use of lasers in space demands the development of laser packaging technology that will enable the devices to survive launch conditions and the space environment during missions that could last five years or more. This paper describes the fabrication of a rugged, laser-welded package for a monolithic diode-pumped solid-state Nd:YAG laser operating at 1319nm that incorporates a redundant pumping system called the Multi-Fiber Pump Ferrule (MFPF). The novel packaging method employs a specially designed housing to which an MFPF, multi-mode fiber pigtail, or single-mode polarization-maintaining fiber pigtail can be aligned and laser-welded into place. Single-mode, highly frequency-stable output at 1319nm is created by end-pumping the Nd:YAG laser crystal with 808nm laser diode light. The MFPF allows multiple laser diode pump modules to be aligned to the laser crystal simultaneously, in order to accommodate either parallel or standby pump redundancy without adding any additional optics. An important aspect of the redundant pump configuration is that it allows the laser design to achieve the required reliability without dependence on availability of ultra-high reliability laser diode devices. Given current laser diode technology, a good way to achieve the reliability necessary for long missions (5+ years) in space is to utilize redundant pumps. Since the MFPF can be laser-welded into place, a stable and reliable alignment between the pump and the laser crystal can be maintained. Environmental testing shows that the laser-welding technique withstands non-operational thermal cycles over a temperature range from –20°C to 55°C, and 22.3 g-rms of random vibration, with little or no degradation of laser output power or performance. This compact, lightweight packaging design is well suited for space flight applications and the laser-welded technique can easily be adapted to many other fiber optic and electro-optic devices in which critical optical alignments must be maintained in a harsh environment.

KEY WORDS: Laser, Packaging, Laser-welded, Space, Multi-fiber Pump Ferrule