Reliable operation of high-efficiency (>70%) 8xx- and 9xx-nm diode lasers

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ABSTRACT

Under the DARPA-sponsored SHEDs program, significant improvements were made to the efficiency of high-power diode lasers. Lessons learned under this program have been successfully transferred to devices across the 800- to 1000-nm wavelength band, enabling efficient pumping of a variety of rare-earth-doped solid-state crystal and fiber lasers. Water-cooled 1-cm laser diode bars operating at 808-nm and 975-nm have previously demonstrated > 70% power conversion efficiency. High-efficiency operation is critical to laser reliability; for a fixed output level, increasing efficiency reduces junction temperature and the degradation acceleration effects associated with it. However, in the effort to maximize efficiency, material and design choices were made which had an unproven impact on the device lifetime, until now. Here we report on the reliable operation of high-efficiency diode lasers (for example, 950-nm diodes have shown stable operation to > 600 hr at 200 W). Root-cause degradation and failure mechanisms of high-efficiency laser diodes are discussed for a variety of device configurations. Additionally, we review our efforts to improve reliability of high-efficiency diode lasers in this wavelength band.

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