

885-nm Pumped Ceramic Nd:YAG Master Oscillator Power Amplifier Laser System

Reduced thermal load results in a higher-performance laser.

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The performance of a traditional diode pumped solid-state laser that is typically pumped with 808-nm laser diode array (LDA) and crystalline Nd:YAG was improved by using 885-nm LDAs and ceramic Nd:YAG. The advantage is lower quantum defect, which will improve the thermal loading on laser gain medium, resulting in a higher-performance laser. The use of ceramic Nd:YAG allows a higher Nd dopant level that will make up the lower absorption at the 885-nm wavelength on Nd:YAG.

When compared to traditional 808-nm pump, 885-nm diodes will have 30% less thermal load (or wasted heat) and will thus see a similar percentage improvement in the overall laser efficiency. In order to provide a more efficient laser system for future

flight missions that require the use of low-repetition-rate (<few hundred Hz) and high-energy laser pulses, laser diodes such as the 885-nm LDA were used for pumping the Nd:YAG laser crystal. This pumping scheme has many potential advantages for improved reliability, efficiency, thermal management, contamination control, and mechanical flexibility.

The advantages of using 885-nm pump diodes in Nd:YAG laser systems are numerous. The epitaxial structures of these 885-nm diodes are aluminum-free. There is a significant reduction in the thermal load generated from the Stokes shift or quantum defects. A Stokes shift is the energetic difference between the pump and laser photons. Pumping at a wavelength band closer to the lasing wavelength can

reduce the thermal load by $\approx 30\%$ compared to traditional pumping at 808 nm, and increase the optical-to-optical efficiency by the same factor. The slope efficiency is expected to increase with a reduction in the thermal load.

The typical crystalline Nd:YAG can be difficult to produce with doping level $>1\%$ Nd. To make certain that the absorption at 885 nm is on the same par as the 808-nm diode, the Nd:YAG material needs to be doped with higher concentration of Nd. Ceramic Nd:YAG is the only material that can be tailored to specific needs.

This work was done by Anthony Yu of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16205-1