Big Blue Laser in a Small Package: Is it Coming Soon?

Coherent Sees Potential for Cheap, Multi-Watt Blue Lasers

By Greg Niven, Coherent, Inc.

The cathode ray tubes and colored phosphors that captivate today's video and television audiences reproduce only 40 percent of the colors perceptible to the human eye. Film and bulb technology at the cinema doesn't perform much better. By comparison, laser-projection displays deliver 90 percent of our perceived color range, which helps to explain why these displays—despite their size, power consumption and cost—drive an annual market estimated at more than $10 million.

Laser vendors have already begun to deliver smaller and more efficient red and green diode light sources. Blue laser technology, however, has lagged behind, delivering either high power or compact size, but not both. Optically pumped semiconductor lasers (OPSL), such as the Sapphire 488-200 from Coherent Inc. in Santa Clara, Calif., could prove to be the exception.

Today, the most advanced OPSL product on the market delivers 200 mW but is priced beyond the reach of most laser display applications. Unlike other solid-state blue laser designs, however, OPSL technology enables output power to be scaled up easily.

2 Watts In a Shoebox?

The output for the next-generation Sapphire should deliver 2 Watts from a shoebox-sized laser head, with up to 5 Watts or more possible. We are beginning to test a 2-Watt prototype Sapphire that we plan to send out to select parties for evaluation this summer and then bring to market as rapidly as possible.

Will it be a cost-effective choice for laser displays? In the near term, pricing for the 2-Watt Sapphire should be roughly similar to the pricing for green YAGs purchased in low volumes. The long-range goal is to bring the cost significantly under $1,000 per laser, although this will require mass production of hundreds of thousands of units, which could be spurred by consumer demand for laser video projectors.

OPSL technology offers such great potential because it relies on proven materials and manufacturing processes. An expensive and potentially unreliable crystal is not needed, as is the case with green YAG lasers. The OPSL chip is based on GaAs semiconductors grown by molecular beam epitaxy, a process known for producing consistent wafers inexpensively and in high volume. The semiconductor chip incorporates quantum wells that emit at 920 nm when they absorb 808-nm light from a diode-pumped laser—the same used to drive Nd:YAG and Nd:YVO_4 devices. A nonlinear crystal doubles the infrared emission to produce a 460-nm (blue) beam.

The optically pumped semiconductor structure produces a single-transverse mode (TEM_{00}) beam that is ideal for display applications. Additionally, OPSL devices offer low noise, long life and a wide operating temperature range.

The laser is constructed by robotic tools that align optical components and then weld them into place on a single, stable ceramic element; this extends the laser's lifetime and eliminates the need for adjustments.

The long lifetime (in excess of 10,000 hours for our low-power Sapphires) and high output is achieved without sacrificing efficiency: OPSL lasers are 90% smaller and 98% more efficient that comparable argon-ion lasers.

These attributes suggest that blue lasers could soon hold their own in the current laser display market, and may enable an age of more affordable and efficient laser projection systems.

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