NEWS RELEASE

Hamamatsu Unveils Highest-Density LD Module as a pump source of 1-kJ Laser used for Fusion Research

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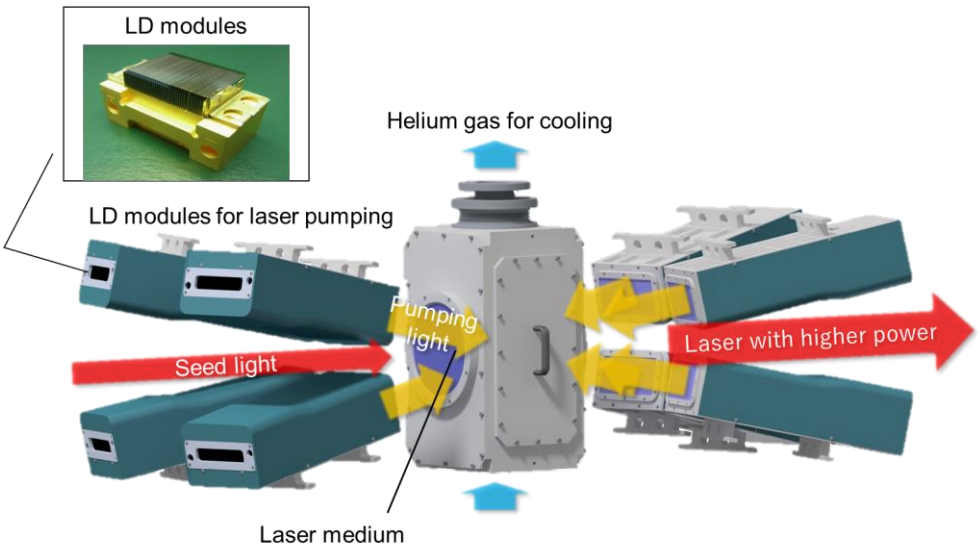
Here at Hamamatsu Photonics we have established proprietary technology that vastly improves the manufacturing precision of semiconductor laser modules or laser diode (LD) modules. This in-house technology has led to successful development of a new LD module with a power density of 23 kW/cm^2. This is about 4 times greater than our current LD modules and the world's highest level among light sources for pumping(*1) lasers in laser fusion applications.

Using these newly developed LD modules as light sources for pumping the laser medium(*2) will achieve laser power in the 1-kilojoule (kJ) class, an important milestone in making laser fusion practical. This will likely accelerate laser fusion research being conducted around the world. Applying the LD module manufacturing technology Hamamatsu established in this new LD module will allow them to design and develop even smaller and more compact LD modules used for usual solid-state laser pumping. In other words, it is possible to achieve the same optical output as currently available commercial LD modules with significant small size.

Research results on this new LD module will be presented at the special symposium in the “IEEE Photonics Conference “entitled “A Technology Roadmap for High Power Diode Laser Pumps for Large Laser Facilities: From Secondary Source Generation to Fusion.” This conference will be held in Rome, Italy over 5 days from Sunday November 10 to Thursday November 14 this year.

*1: Pumping is the process by which electrons in an atom or molecule are raised to a higher energy level through light absorption.

*2: Laser medium is a material that stores energy from an outside source and amplifies the laser passing through it by imparting energy to the laser.



Laser amplifier for laser fusion

The laser medium is excited by LD modules to store energy.
When the seed light passes through the laser medium, it receives energy from the medium to produce higher power.

Background of development

Nuclear fusion is a reaction in which atomic nuclei are fused together to form a heavier nucleus and release a huge amount of energy in the fusion process. Laser fusion is a promising technology for creating nuclear fusion by irradiating high-power lasers into a fuel capsule containing deuterium and tritium. Laser-fusion power production therefore, holds great possibilities and is eagerly awaited as a carbon-neutral, next-generation energy source.

In major laser fusion research facilities around the world, large-scale demonstration experiments are being conducted using flashlamp-pumped large laser systems to achieve the high gain needed for boosting the output energy to about 10 to 100 times the energy input. However, the number of laser irradiations or ‘shots’ is limited to just several times a day due to the time needed to cool the laser medium. The current view is that putting laser-fusion power production to practical use requires making the fusion reactions take place at high repetition rates and continuously extracting the generated energy. Hamamatsu Photonics have been working to develop high-power pumping LD modules capable of operating at high repetition rates.

Overview of newly developed LD module

In high-power laser systems used for laser fusion, the laser medium must be efficiently pumped by high-intensity laser light to obtain high light output energy. Increasing the output power of LD modules for laser pumping requires technology for high-density stacking of compact LD bars which are as small as 1 cm wide yet produce high power. Until now, there have been issues with stacking such LD modules due to problems with leakage current in supply to LD bars and LD bar cooling stability.

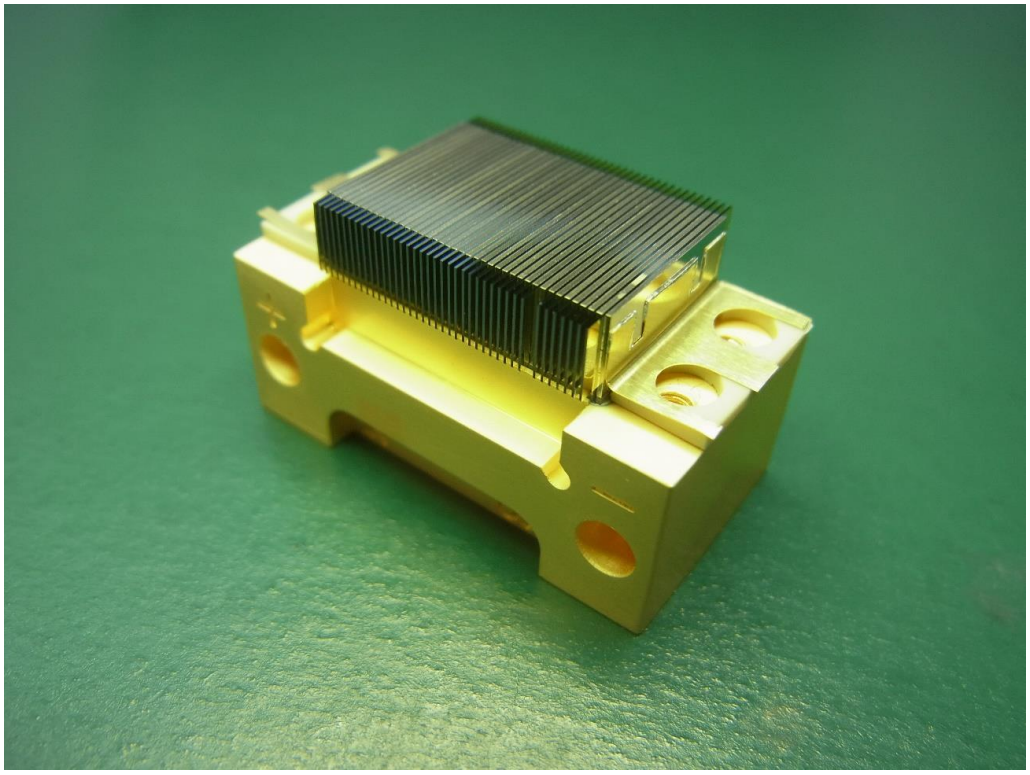
Hamamatsu Photonics succeeded in establishing their unique high-density mounting technology for LD bars by developing special mounting jigs and making crucial improvements to the high-melting-point solder joining technique and heat sink structure. This allowed suppressing the leakage current and increasing the cooling efficiency, leading to successful development of an LD module with an output density of 23 kW/cm^2. This is about 4 times higher than Hamamatsu’s current LD modules and means they can now provide an LD module at the world's highest level for laser fusion applications.

Using these newly developed LD modules as pumping light sources in laser systems for laser fusion will help achieve laser power in the 1-kJ class which is considered an important milestone in making laser fusion practical. This will prove a major contribution to research and development toward achieving fusion energy that is expected to demonstrate power generation in the 2030s. The LD module manufacturing technology Hamamatsu Photonics established can also be applied to light sources for pumping high-power lasers to remove space debris and to laser pumping light sources for extreme ultraviolet light sources used in semiconductor microfabrication.

Hamamatsu Photonics aims to make this newly designed and developed LD module commercially available within three years.

●Main specifications

Parameters	New LD module	Unit
Power density	23	kW/cm^2
Peak optical output	32	kW
Wavelength	940	nm
Repetition rate	10	Hz
Pulse width	0.3	ms



External view of newly developed LD module