Litron focus on PLD

Pulsed laser deposition (PLD) is typically used to deposit thin films or multilayers on substrates such as silicon wafers

A high-power pulsed laser beam is focused onto a target material. This material is vaporised in a plasma plume and deposited as a thin film on a substrate.

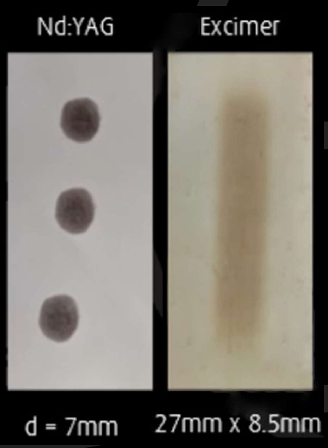
This process can occur in ultra-high vacuum or in the presence of a background gas such as oxygen, which is commonly used when depositing oxides to fully oxygenate the deposited films.

Excimer lasers are used for PLD as they deliver high energy pulses in the UV from inert gas/halide mixtures.

However, due to modern day optical advancements, reliable high energies from solid state Nd:YAG lasers are now established and can offer many advantages.

Nd:YAG lasers give much higher energy density at the target for a given pulse energy

While the Excimer laser beam is high energy, it is also large, rectangular, and needs to be passed through a beam shaping mask prior to focusing, resulting in a large energy loss. The beam from a Nd:YAG laser is smaller, round, and very intense in comparison. A lower energy Nd:YAG can provide the same required fluence as a much higher energy Excimer laser.



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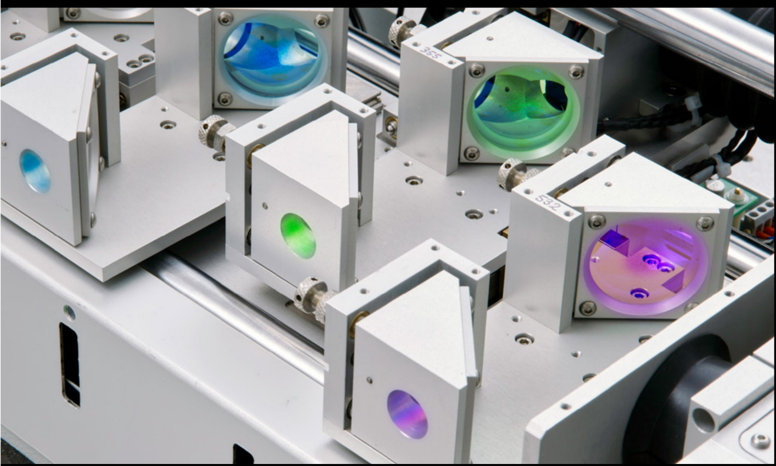
Lower cost of ownership

Solid state lasers benefit from having a lower cost of ownership compared to Excimer lasers. The gas mixture of an Excimer laser is required to be replaced every ~1 billion shots. These gas changes are becoming increasingly more expensive and the supply of the gas can be difficult to obtain due to global supply chain problems. In addition to the gas replacement, the electrodes will degrade and need to be replaced every ~3 billion shots.

In comparison the Nd:YAG laser requires flashlamps and water filters to be changed every year.

These are low-cost parts, and the simple maintenance procedures to replace them can be performed by the operator, without the need for manufacturer trained engineers or laser system returns.



Flexibility of wavelength selection

The laser selection in PLD is dependent upon the material being processed to create a plasma on the target surface. Excimer laser wavelengths are fixed and dependent upon the gas mixture used.

Nd:YAG solid state lasers have the flexibility to change wavelength between 266nm, 355nm, 532nm, 213nm and 1064nm simply by interchanging a few optical components.

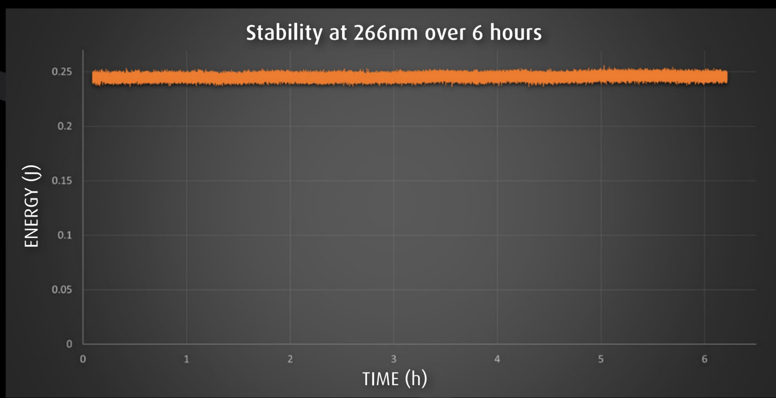
This makes the Nd:YAG laser a flexible tool for a wide range of materials and substrates.

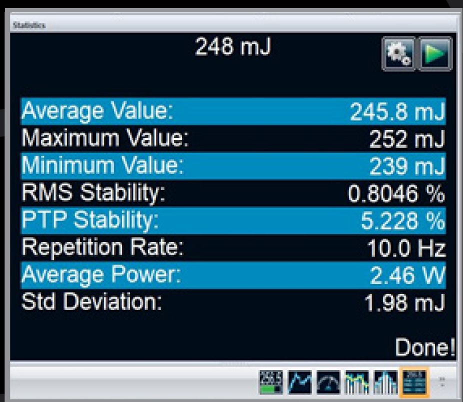
Excellent long-term stability

Since laser fluence directly affects film quality, stoichiometry and deposition flux, it is important to maintain a stable laser output throughout the deposition process.

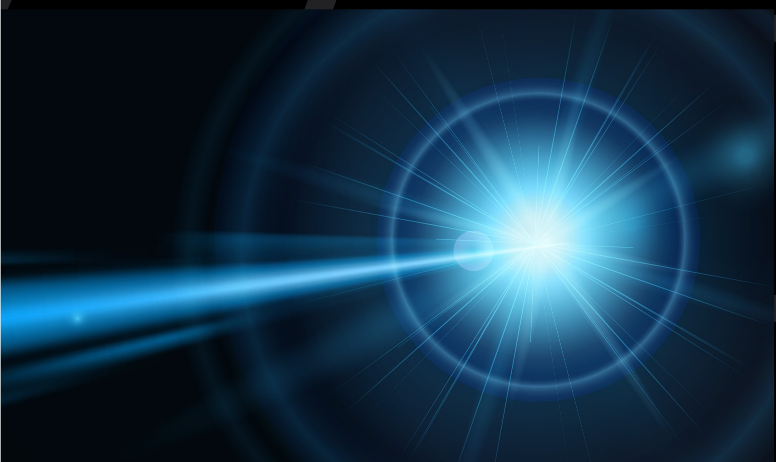
Litron's continuous and fast motorised auto-tuning function maintains a set energy over long periods of continuous operation. Auto-tuning is especially important when using a laser in the UV when harmonic crystals will naturally self-heat and drift over time (meaning the pulse energy decreases).

The stability plot (right) shows a 6 hour soak test of a Litron LPY 767-10 laser running at 266nm.



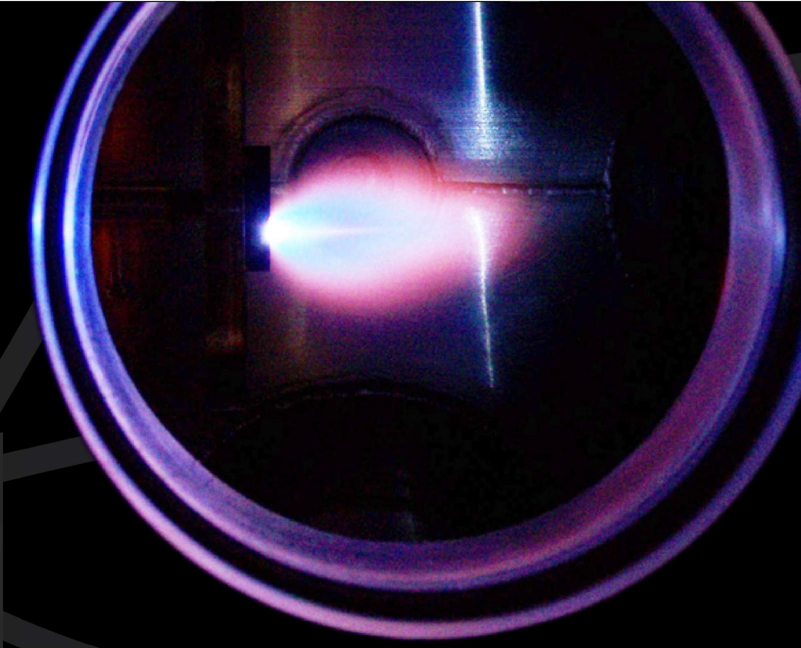


Energy meter reading



Precise process control

Motorised attenuation (by way of a half-wave plate and polariser) ensures continuous adjustment of the output energy with negligible effect on either the spatial or temporal pulse characteristics including stability and beam divergence. Attenuators are available for all wavelengths.



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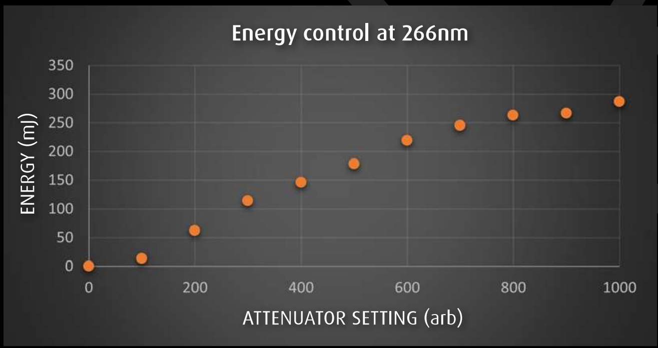
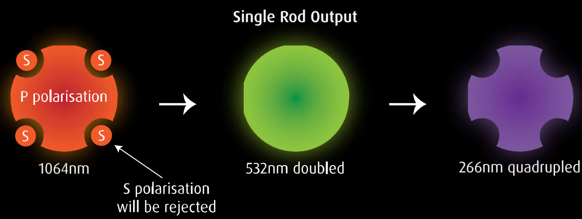


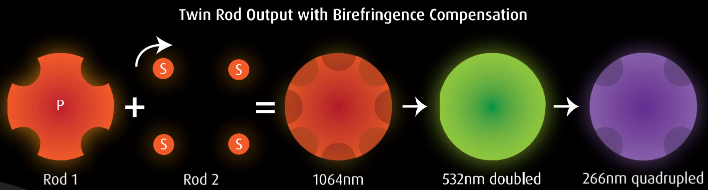
Twin rod birefringence compensation

Other manufacturers of Nd:YAG lasers use a single rod oscillator design that will exhibit strain birefringence. This is a thermal effect in Nd:YAG caused due to heating the rod by pumping it with high average power.

A twin rod, birefringence compensated design works by compensating the birefringence in one rod against the other. Two rods are used and the polarization of the beam emerging from one rod is rotated through 90 degrees before it passes through the next.

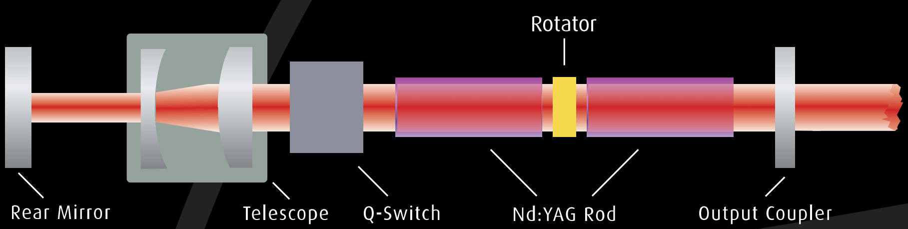
This provides improved spatial profile, extraction efficiency and higher harmonic conversion.

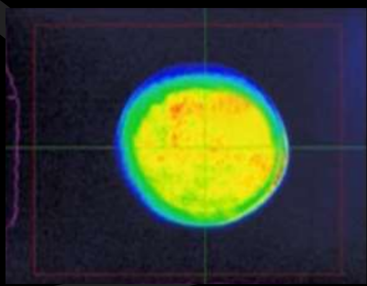




Low divergence resonator design and smooth spatial profile

Litron's unique stable-telescopic resonator design is ideal for PLD, with low divergence to improve focusability and a smooth spatial profile.





Stable-telescopic beam profile

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