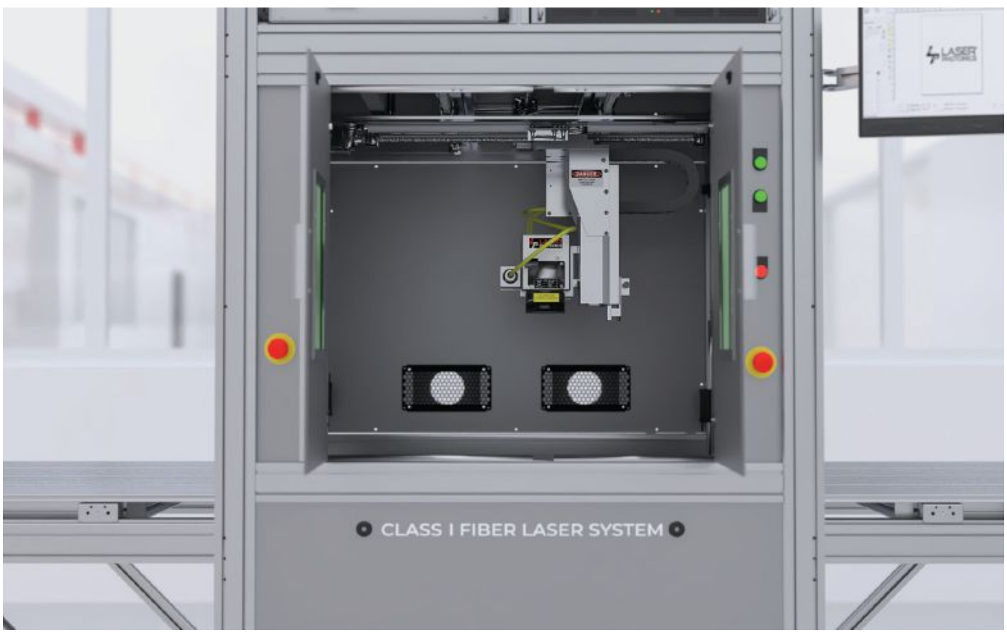
CONTRIBUTED BY ANNA VODOPYANOVA

Laser Cleaning Fast-Tracks Surface Preparation

Laser cleaning solutions can provide a faster clean for manufacturers with time-saving and cost-effective benefits.



↑ **Laser Photonics' MegaCenter Class I laser cleaning system's enclosed design aims to prevent fume exposure and simple installation of a fume extractor.**

Source (All Images) | Laser Photonics

Compared with laser cutting, laser cleaning has seen slower adoption in manufacturing, having reached industrial viability only in the past decade or so. Recent advances in beam delivery technology have made laser surface treatment more effective, while automated, turnkey systems became more accessible. Now, manufacturers of automotive parts, electronics, medical devices, industrial machinery and other sectors are increasingly turning to lasers to treat surfaces.

In high-quality metal parts manufacturing, effective surface preparation is a critical prerequisite for uncompromised plating, coating, painting, welding, gasketing and other downstream processes. Laser cleaning meets this requirement through the selective removal of oxides, oils, residues and films with minimal impact on base material properties.

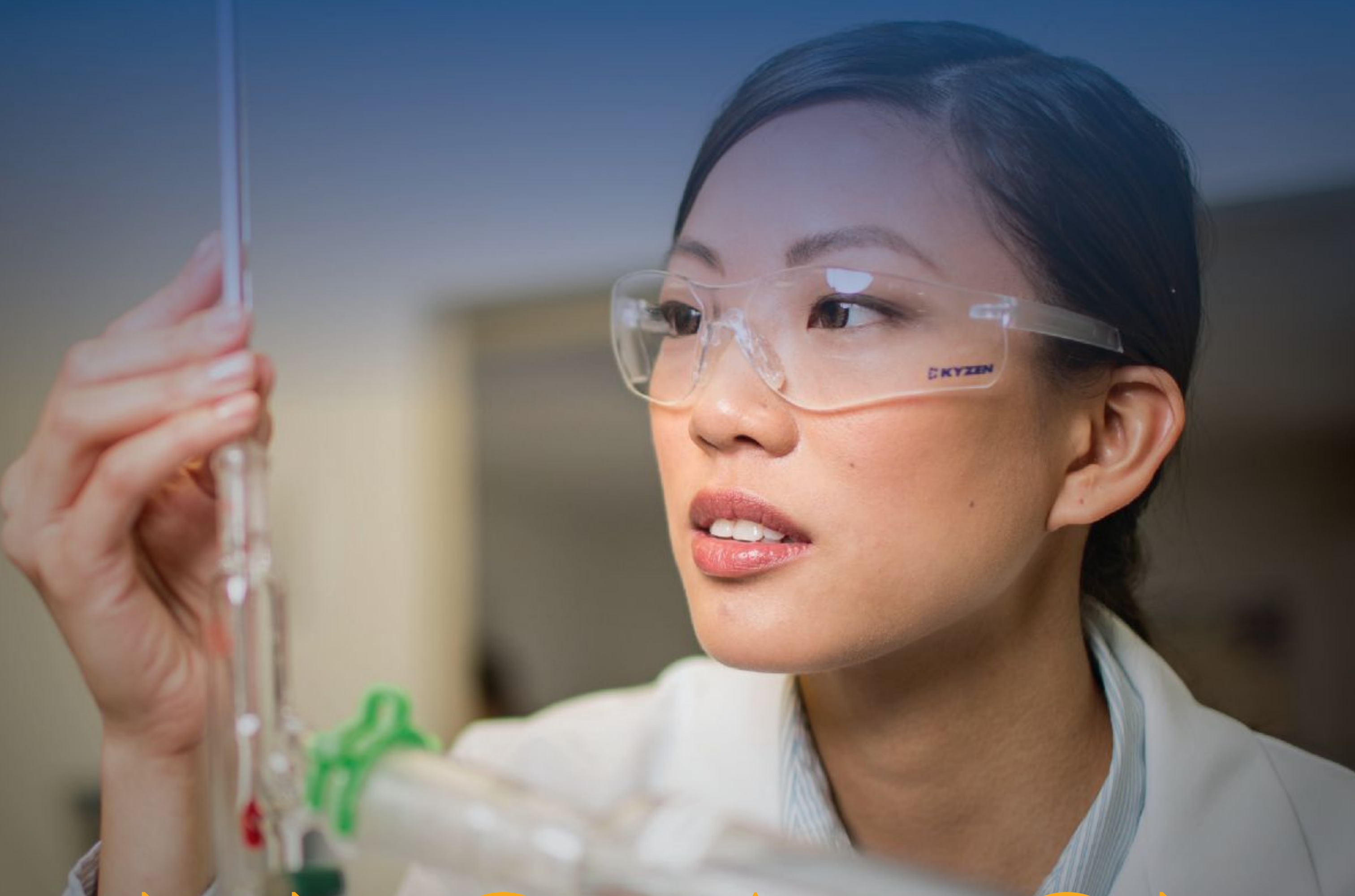
No mechanical or chemical interaction is involved — only controlled laser energy.

Laser cleaning explained

Whereas laser cutting relies on ablation combined with melting — concentrating high energy in a single spot to fully sever material — laser cleaning uses a rapidly scanning beam at much lower power levels starting from 50 watts. At the lower end, the beam is sufficient to vaporize contaminants such as grease or films. At higher power levels, it ablates tough substrates like rust, galvanization or powder coating, actively ejecting them from the surface. The greater the gap between the contaminant's ablation threshold and the base material, the more controlled the process.

Laser systems are built to operate in either pulsed or continuous wave (CW) mode. A pulsed laser emits short bursts of light (nanoseconds to microseconds) separated by pauses during which energy accumulates. The peak power of a single pulse can exceed 10 times the laser's average power output. On the contrary, a CW laser emits light continuously and does not rely on costly, pulse-shaping components. This relatively new technology has enabled manufacturers to offer high-power laser systems

HOW DO CLEANING TECHNOLOGY BREAKTHROUGHS ADVANCE?



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↑ **Laser cleaning can provide proper surface preparation through the selective removal of oxides, oils, residues and films with minimal impact on base material properties.**

at affordable prices. Still, pulsed lasers are favored in high-precision applications requiring low heat.

Whether pulsed or continuous, the parameters of a beam are adjustable to match the material properties of the workpiece. These are: power output, power density, pulse frequency and pulse duration. A faster cycle will require a higher-power laser and increased scanning speed, while heavy contamination may call for slower processing time or multiple passes.

Another variable setting is the irradiation area. A laser beam scans the surface at a specific focal distance from the treatment area, uniformly distributing energy in the shape of a line or rectangle. The operator would modify this shape for specific workpiece geometries.

An optimized cleaning alternative

Laser cleaning equipment manufacturers now offer solutions ranging from handheld Class IV systems on wheels to fully enclosed Class I setups with robotic part handling, machine vision and AI assistance. Among these providers is Laser Photonics, based in Lake Mary, Florida. Its portfolio of standard and custom options was recently expanded by its acquisition of CMS Laser and Beamer.

“Our clients approach us looking to replace cleaning methods that use chemical baths. These can take hours — even overnight — and still don’t guarantee a surface clean enough for sterile applications," says Kathy Spaugh, sales engineer at Laser Photonics. Managing and disposing of these chemicals is time-consuming and expensive, she adds.

Abrasive blasting has similar drawbacks. Although the use of harmful silica sand has been significantly reduced — mitigating the associated health risks — modern grit blasting still requires containment and PPE. It can also damage or distort materials and generate dust and waste, adding up postprocessing labor and costs.

"We can help clean in a faster, more environmentally friendly way," Spaugh says. "And it all comes down to saving our clients time and money."

Spaugh also notes that, like sandblasting, laser cleaning offers the benefit of improved adhesion. This is achieved when a laser beam is programmed to affect the substrate and produce a micro-texture on its surface, promoting stronger and more reliable bonding with subsequently applied coatings.

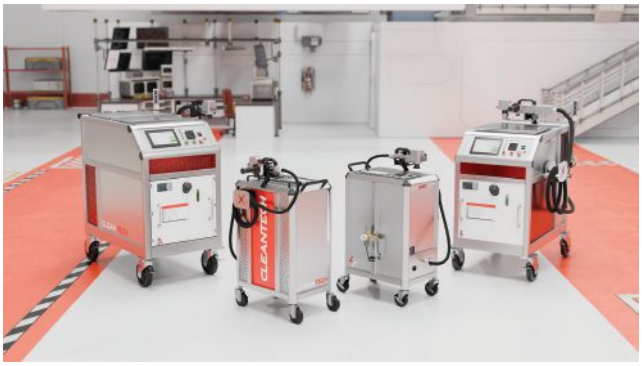
Navigating system configurations

Laser processing is versatile and can extend well beyond metal applications, but choosing the right configurations is critical. An improperly matched setup may damage the workpiece by warping, charring and cracking — or fail to remove contaminants effectively. To avoid issues, engineers evaluate material characteristics such as thermal conductivity, heat sensitivity, flammability and reflectivity.

System configuration also depends on workpiece geometry, the properties and volume of surface residue, production cycle speed and the desired level of automation. These considerations shape how the laser is delivered and how consistently results can be achieved. To validate these variables in real-world conditions, Laser Photonics routinely accepts customer samples for evaluation and process development prior to system selection.

Once parameters are validated, the focus shifts to execution. Motion control is central to precision. The laser scanhead is guided by an XYZ gantry — or for more complex 3D cleaning, a robotic platform. In setups with automated part handling, machine vision helps orient components so each pass hits the right spot.

As the laser removes surface residues, airborne particles are generated that can affect sensitive components and beam quality. Proper fume extraction and filtration allow



↑ **Laser Photonics' family of CleanTech mobile, handheld laser cleaning solutions.**

continuous operation while protecting both equipment and the finished part.

Safety is built in. In a Class I system, laser radiation is fully contained within the workcell. Interlocks stop the laser if any doors or panels are opened, and emergency stop buttons are positioned for quick access, so operators can focus on production without risk.

While operators can benefit from training and a basic understanding of lasers, user-friendly software and automation reduce the number of manual steps.

"You load the samples into a fixture and position it inside, then start the cycle and move on to prepping the next batch while cleaning runs in the background," says Spaugh, describing Laser Photonics' semi-automated MegaCenter designed to process multiple samples at once.

The combination of validated process development, controlled motion delivery and built-in safety reflects a broader shift in industrial manufacturing: advanced laser systems are now shop floor-ready. They are engineered for integration, scalability and everyday production use.

"If we had a metric for laser cleaning, we would win hands down," Spaugh says. "The degree of clean is night and day compared to sandblasting."

ABOUT THE AUTHOR

ANNA VODOPYANOVA is technical editor for Laser Photonics, where she develops content focused on laser applications in industrial manufacturing. She holds an M.A. in media and mass communications from the University of South Florida.

CONTACT: laserphotonics.com