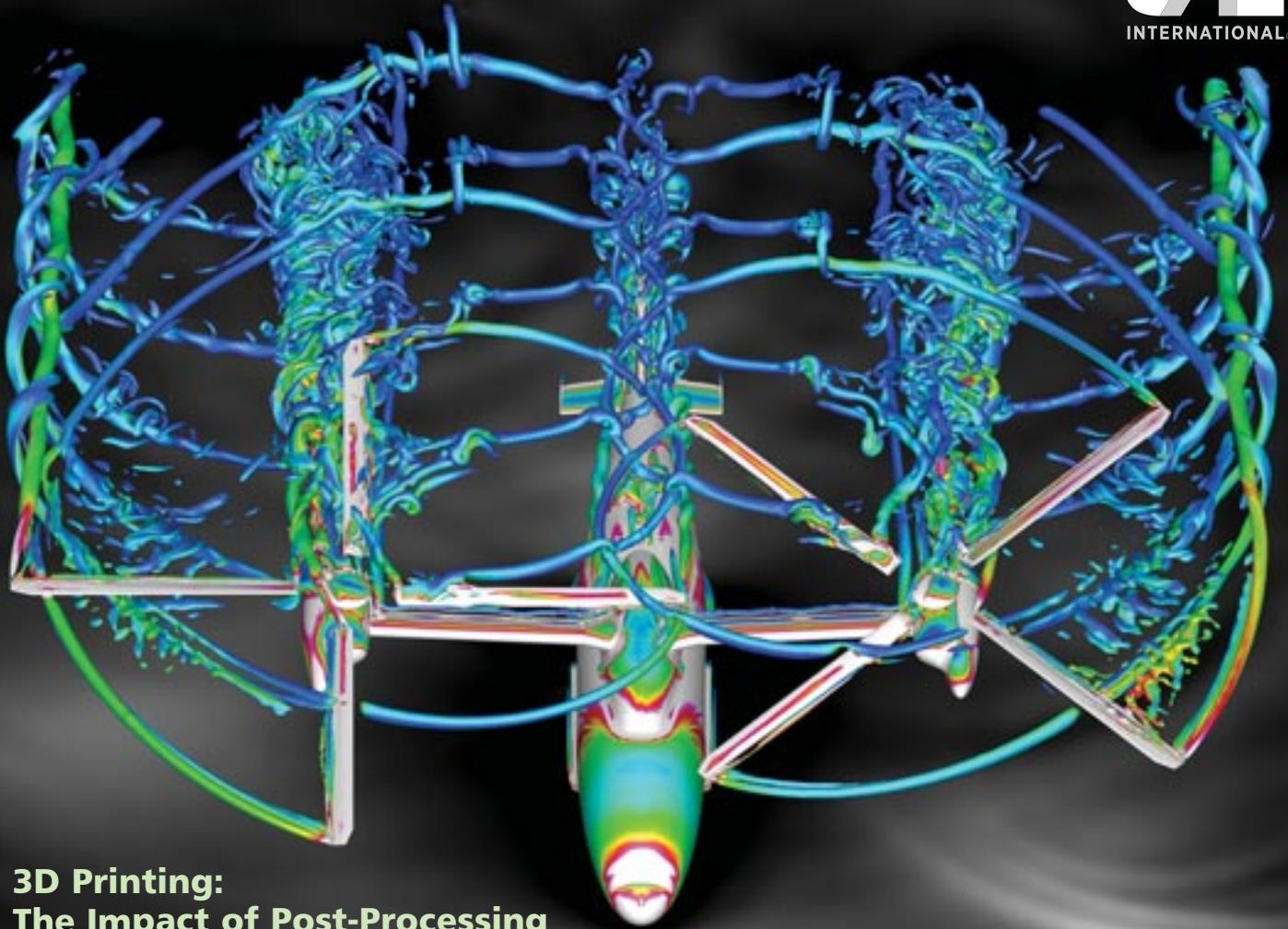


TECH BRIEFS

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Cleaning or Etching Items with Unique Geometries

Cleaning, an integral part of many manufacturing and maintenance processes, is often critical to the performance of a broad range of technologies in the semiconductor, defense, MEMS, photonics and biotech industries.

“Cleaning,” in this case, refers to the use of agents such as solvents, acids or bases to remove unwanted particulates and other contaminants from products ranging from optics to semiconductor and electronic devices. It also refers to the etching process utilized in semiconductor fabrication, where the “cleaning” is the precision removal of thin layers of material.

Today, many of these processes are relatively standardized. Semiconductor wafers, for example, are produced in several sizes and processed the same way, no matter the type. However, for products with non-standard geometries, shapes, sizes and even weight, cleaning takes on a new dimension: figuring out how to optimally get each item in and out of the equipment at each stage of processing.

Within this category are a potpourri of items such as optical lenses for the world’s largest telescopes and high-energy lasers, the crystals used in nuclear sensors or guidance systems, glass substrates, MEMS devices, probe sensors, medical implants, chemically machined subcomponents, etc. With these types of items, creative solutions must be employed to load items in and out of what is typically a multi-stage process. This can include utilizing automated gantry robots, machined fixtures and loading carts.

Careful consideration must also be given to the orientation and, potentially, the rotation of the item after it enters the process baths.

“We are not just concerned with the cleaning equipment, but also how to get the products in and out of that tool,” says Louise Bertagnolli, president of JST Manufacturing (Boise, ID), a specialist in wet processing and precision cleaning equipment. “The handling of non-standard items of various geometries, sizes and weights is a factor that most customers don’t think about,” adds Bertagnolli. “Instead, they focus almost solely on the cleaning process – the temperatures and chemical concentrations. Yet, product handling can impact the



Optics up to 300 pounds are loaded onto the JST Automated Optics Cleaner where they are cleaned, rinsed and dried prior to being installed in the NIF facility.



Product handling can impact the amount of chemicals required, processing time, and even quality of cleaning.

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Lifting, Transporting with Gantry Robots

Companies that choose to automate a cleaning process usually do so to ensure

the repeatability of cleaning results. This means precisely controlling the measurement and dispensing of the cleaning agents and rinsing solutions. It also means providing the systems and tools necessary to transport the items from one bath to another.



Intro

Cov

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For this, robots are often used to lift and transport items to multiple stations or modules.

At companies like JST, this necessitates working closely with automation partners such as Bosch Rexroth (Charlotte, NC) to develop cleaning stations using linear motion and electric drive and control technology.

In some cases, gantry robots are the only solution, particularly for heavy items that may be too much for workers to handle safely. Bertagnolli has seen products that must be lifted that exceed 50, even 100 lbs. In a project for Lawrence Livermore National Laboratories' National Ignition Facility (NIF), JST was charged with figuring out a solution for handling thousands of heavy optical lenses.

NIF, the world's highest-energy laser system – a stadium-size machine – consists of 192 laser beams that will focus nearly two million joules of energy and create temperatures and pressures that exist in the cores of stars and giant planets. By harnessing the massive power generated by its lasers, NIF is able to create conditions and conduct a wide range of experiments never before possible on earth.

NIF is also a cornerstone of the National Nuclear Security Administration's effort to maintain the United States' nuclear deterrent without nuclear testing and plays a vital role in reshaping national security in the 21st century. Other NIF missions include finding new sources of pollution-free energy, and studying physics such as fusion and other sciences in a manner more advanced than ever before.

Each of NIF's 192 beams is supported by an array of optics (lenses) – up to 50 lenses for each beam - depending on the type of experiment being performed. Maintaining the cleanliness of thousands of optics is crucial to the success of the various types of laser-based experiments.

"If these lenses were not as clean as possible then we would start to degrade the performance of our laser," explains Patrick Williams, NIF optics maintenance manager. "The optics are heavy and rather large, so we don't want to handle them a lot," adds Williams. "JST suggested that there might be an easier and more cost-effective way to transport, clean and inspect the optics. They came back with an original design, and then we tweaked it into a system that has worked for over 16 years."

One of the innovations in the NIF cleaning tool, which was a tank-like configuration, was to eliminate the need to move



Racks and fixtures need to be designed to safely handle parts and the fixtures themselves must be designed to withstand the chemicals involved.

the optics to different locations to perform the washing, rinsing and drying functions. In lieu of moving the optics, all cleaning, rinsing and drying is done in one tank. The chemistries move, not the product.

"Our engineers suggested that rather than transport these heavy optics for such functions, we could simply transport the chemistry (solutions) to the optics in a fixed location," explains Louise Bertagnolli. "We also designed a sling-like device to hold the optics and also let technicians rotate them during the inspection process."

To date JST has built two cleaning tools for NIF. The first tool was used for the very beginning of the facility. "A second tool

was built to provide us with dual capacity," Williams explains. Because NIF has become a production facility, where many scientists and companies are performing research, we also wanted to be able to clean a higher volume of optics and also get away from single-point failure."

Machined Fixtures

Bertagnolli says another important element to consider is the fixturing – the devices that hold or position the products being processed. Single or multiple item fixtures are typically designed and machined to fit the specific application. Because precision cleaning equipment is largely a task involving metal fabrication

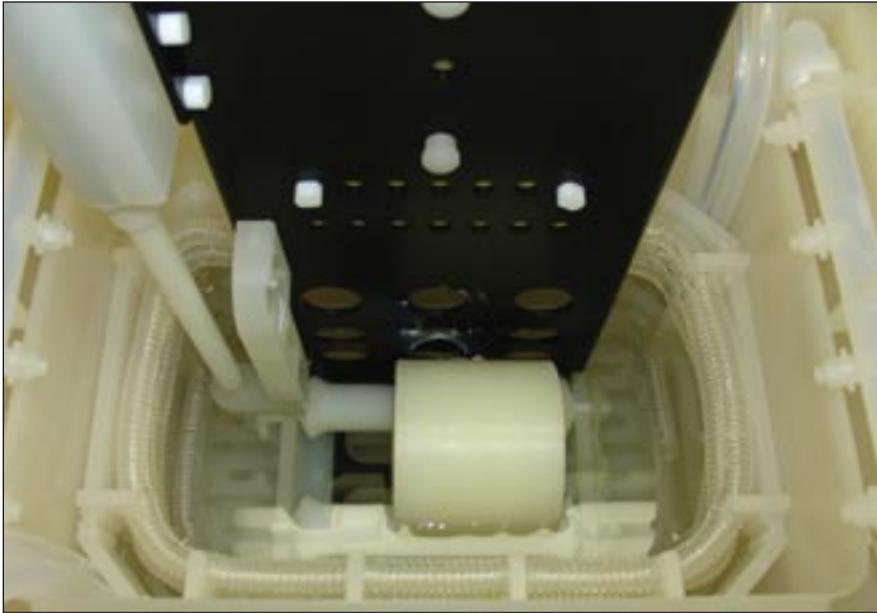


Intro

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JST Ortec sensor ensures repeatability in that product handling system.

and machining, suppliers like JST can also provide custom designed fixtures. Well-designed fixtures can even accommodate quick-change inserts that allow it to be re-used for other parts.

Orienting the Part

Attention should also be given to optimizing the orientation of the part if it has blind holes or other geometric features facing up that can hold chemistry when lifted out. The same holes, if horizontal, can create unwanted bubbles or air pockets. For these reasons, it might

be necessary to design a solution that orients the part in a certain direction and then rotates it later in the process. Even if no blind holes are involved, etching the entire surface of a part may require rotating the part while minimizing contact with the surface.

Such was the case in a project JST was involved in that involved the cleaning of silicon “seed rods” that grow the polysilicon ingots from which the chucks are made. The seed rod cleaning equipment utilized a gantry robot to move the ingot-carrying cylindrical carriages through a

sequence of etch baths. JST designed a custom fixture that rotates the rods to ensure they etch evenly.

“The rotational fixture enables the rods to be cleaned to a very high purity,” Bertagnolli notes. “We incorporate rotational fixtures quite often for cleaning.”

Attention Early in Design Phase

According to Bertagnolli, sufficient consideration of these factors must be given early in the design phase. Racks and fixtures need to be designed to safely handle parts and the fixtures themselves must be designed to withstand the chemicals involved. “With a full engineering staff and 3D modeling, JST can complete a structural analysis and look at the deflection and really have a good idea before anything is ever built,” says Bertagnolli.

In some cases, her company is called in to consult on handling solutions for other provider’s equipment or when manual loading/unloading proves problematic.

“There are a lot of different ways to handle the issue,” says Bertagnolli. “It just takes some engineering, manufacturing capability and experience in the industry. Given that so much is invested in the cleaning process tool, it makes sense to ensure repeatability with an appropriate product handling system.”

This article was written by Jeff Elliott, Technical Journalist. For more information, contact JST Manufacturing Inc. at info@jstmfg.com, visit <http://info.hotims.com/72989-204>.

Clear Vision for UAVs

The rapidly expanding world-wide use of unmanned aerial vehicles (UAV) — drones — is driving a growing market for specialized imaging technology. According to Chris Yiu, General Manager, High Performance BU at SmartSens Technology (Santa Clara, CA, Shanghai, China), there are two basic functions for imaging technology aboard drones: one is optical flow, collision-avoidance sensing; the other is video capture of objects on the ground. With the recent emphasis on self-flying drones, collision-avoidance is of major importance.

Collision-Avoidance Imaging on Self-Flying Drones

Collision-avoidance for self-flying drones requires very precise and accurate

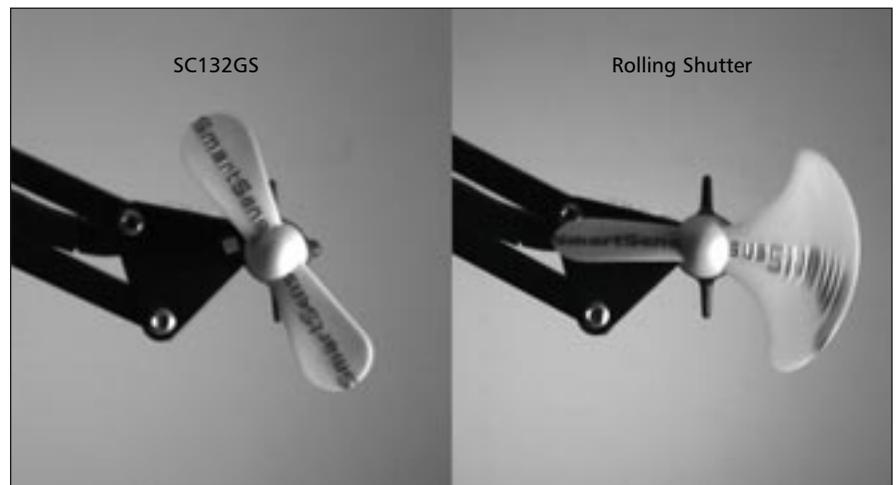


Figure 1. Left: Turning propeller photographed with a SmartSens global shutter; Right: Turning propeller photographed with a rolling shutter. (Image courtesy of SmartSens Technology)