tag MEDICAL PRODUCTS Newsletter

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ADVANCING SURGERY: NEW TAG MEDICAL'S LASER TECHNOLOGY

With ever-growing demands for precision and efficiency in surgical instruments manufacturing, laser technology continues to push the boundaries of what's possible.

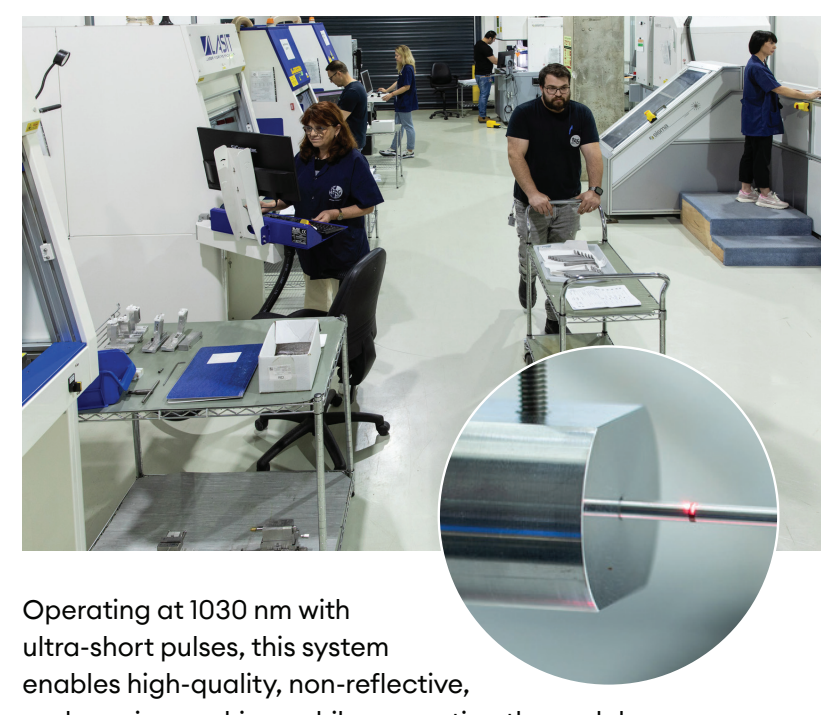
Laser technology is a cornerstone of modern surgical instruments production, enabling precision, efficiency, and consistency across critical processes such as marking, cutting, and welding. At TAG Medical Products, a range of advanced laser processing techniques is applied to materials including stainless steel (300 and 400 series), PH17-4, Nitinol, anodized aluminum, and titanium screws – each selected for their s trength, biocompatibility, and corrosion resistance. All processes undergo comprehensive process validation.

To leverage these advancements, TAG Medical Products has recently implemented several laser systems from leading global manufacturers. Integrated with automated production lines, these systems enhance manufacturing efficiency and ensure consistently high-quality outcomes.

HIGH-PRECISION LASER MARKING

Laser marking plays a vital role in the functionality of surgical instruments, ensuring compliance with industry regulations and maintaining traceability. TAG Medical employs fiber laser marking with nanosecond pulses at a 1064 nm wavelength, delivering engravings on various metal medical-grade materials and plastic grades like PEEK or Radel. Automated marking systems applied for high-volume production devices.

For applications requiring high-contrast black and corrosion-resistant markings, TAG introduced new picosecond laser technology.



Operating at 1030 nm with ultra-short pulses, this system enables high-quality, non-reflective, and precise markings while preventing thermal damage. This method is particularly effective for stainless steel surgical drills and screws and operates up to three times faster than standard fiber lasers. It increases the corrosion resistance by 50% during the reprocessing cycles.

LASER WELDING AND AUTOMATION

Laser welding is widely used in the medical industry due to its minimal thermal impact, allowing for strong, clean joints while preserving material properties. However, certain challenges require expert handling – particularly when welding thin-walled tubes with uneven gaps. To prevent laser penetration through the material, it is essential to carefully control intensity and pulse duration.

Fiber lasers provide high precision but are less forgiving when dealing with inconsistent gaps. For this reason, TAG utilizes Nd: YAG lasers, which offer higher power density and greater adaptability. However, since these lasers rely on a xenon lamp, their intensity tends to fluctuate, requiring precise control to maintain uniform energy output.

Another challenge TAG faces is welding HHS tubes, commonly used in catheters for minimally invasive cardiology. In this application, multiple intertwined wires can separate due to insufficient weld penetration, and variations in material thickness further complicate the process, demanding meticulous parameter adjustments.

Achieving high-quality welds requires optimizing welding parameters, designing appropriate fixturing, and combining multiple welding techniques to ensure consistent results.

At TAG, we employ a variety of laser systems, from fully automated welding cells for high-volume production to manual welding stations where precision welding is performed under a microscope.

Our capabilities include a newly integrated dual-point automated welding system for mass-production devices and a high-precision welding system for implant manufacturing.

Successful welding is only part of the process, post-weld treatments are equally critical. These include thorough cleaning, heat treatments to enhance mechanical properties, and passivation to restore surface protection, ensuring the highest quality and durability of the final product.

ADVANCED LASER CUTTING CAPABILITIES

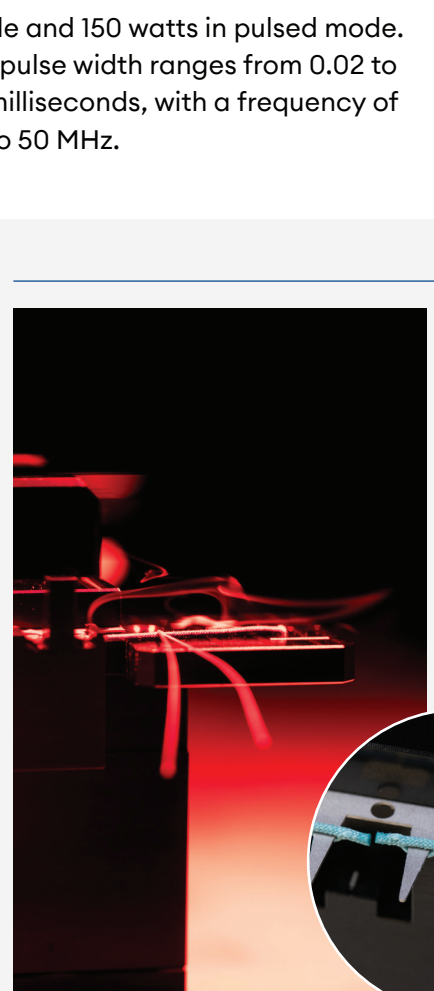
Laser cutting is essential for surgical tools requiring flexibility. It allows for precise and complex geometries without distorting metal structures.

TAG recently introduced a new tube-cutting system - the StarCut Tube by COHERENT. It enables underwater cylindrical cutting to prevent thermal damage and oxidation.

It is equipped with a fully integrated PowerLine FL fiber laser system, operating at 1070 nm with an output power of 250 watts in continuous mode and 150 watts in pulsed mode. The pulse width ranges from 0.02 to 50 milliseconds, with a frequency of up to 50 MHz.

Underwater cutting eliminates the thermal effect of metal by diffusing the laser in the water and keeping the internal surfaces cool. It also ensures a clean-cutting environment by removing the fine-cut particles. This allows effective manufacturing of screws, drills, and flexible cutting guides used in ligament reconstruction. During the process, oxygen is used to enhance the cutting depth. Additional post-processing steps, including pickling, cleaning, and sterilization, ensure compliance with medical standards.

Currently, TAG focuses on PH17-4 stainless steel cutting, with plans to accommodate additional materials and implement automated bar feeding for greater production efficiency.



STREAMLINED SUTURE ANCHOR LASER CUTTING

To further optimize manufacturing, TAG has also improved the production of its PET multifilament suture anchors using laser technology.

Traditionally, cutting and heat- sealing the ends of the anchors were performed manually in separate steps. The new laser-based process automates both tasks in a single operation,

utilizing the CombiLine laser marking series with the CO_2-based laser subsystem PowerLine C. This system operates at a wavelength of 10.6 µm, with an output power of 30 watts, a pulse width of 1 µs, and a pulse frequency of up to 25 MHz. Additionally, a vision system was employed for precise detection of cutting locations. This advancement enhances consistency and efficiency in the production of suture anchors for meniscus repair procedures.

LOOKING AHEAD: EXPANDING LASER APPLICATIONS

As the demand for high-quality arthroscopic surgical tools grows, TAG Medical Products is investing in further automation and laser technology advancements. Plans include

integrating collaborative robots (cobots) for laser marking, optimizing workflows for high-mix, low-volume production, expanding vision-based inspection systems for enhanced quality control, and replacing certain CNC and EDM wire-cutting processes with laser cutting. This allows us to remain committed to our customers and deliver innovative and precise solutions for the medical industry.