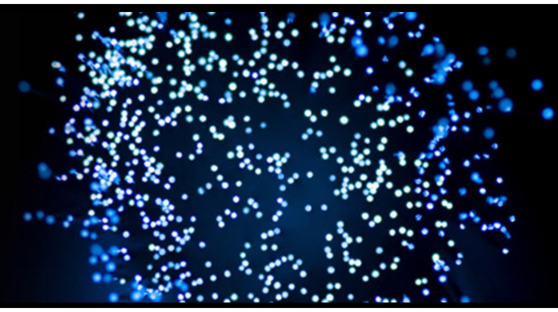
IntriMed TECHNOLOGIES

Collaboration Development Manufacturing

Manufacturing In Depth



Ultrafast Athermal Lasers

Ultrafast athermal lasers, or femtolasers, are revolutionizing medical device manufacturing by literally taking the heat out of the machining process. Until recently found only in top research laboratories, IntriMed's laser technology removes target materials atom by atom using extremely short pulses lasting 50 – 1,000 femtoseconds, or quadrillionths of a second. These pulses, too brief to create the heat damage associated with conventional lasers, are capable of cutting, drilling and machining micro-scale components made from virtually any material with extreme precision.

This technology is helping medical device manufacturers dramatically shrink the scale of their devices while simultaneously increasing manufacturing efficiency through fewer steps and higher yields.

The Old Wave.

Traditional lasers, commonly called continuous wave (CW) lasers, have long been used for precision cutting (ablation.) They work by emitting a steady stream – or wave - of protons focused on a target, essentially melting or boiling the base material in order to remove it. The resulting heat can cause considerable damage to the area surrounding the cut, including the creation of a heat affected zone (HAZ), recast layer, and micro cracking (Figures 1, 2.) For very tiny structures, and those made from polymers or other materials with low melting points, this thermal stress creates intolerable collateral damage.

Additionally, CW laser ablation results in material slag and burrs which require extensive post processing rework to remove (Figure 3). CW lasers are also incapable of achieving the precise cuts and high tolerances required to produce the near-nano-scaled components that comprise the next generation of minimally invasive devices.

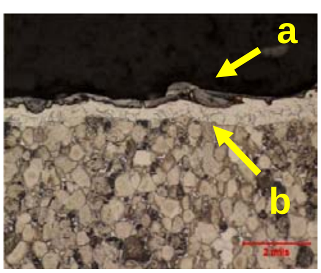


Fig 1. Recast layer (a) , HAZ (b)

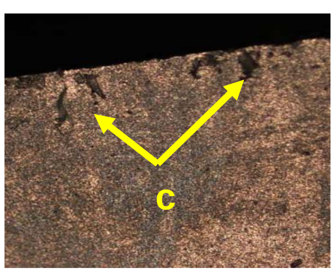


Fig 2. Surface microcracking (c)

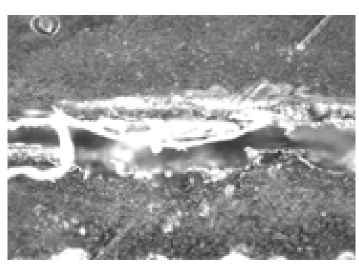


Fig 3. CW laser cut in stainless steel results in jagged cut w/slag.

Athermal Laser Quick Facts

Sample Applications

Vascular stents
Needles
Drug delivery systems
Implantable devices
Microfluidics

Base Materials

Polymers

- Pebax®
- Teflon®
- Polyimide tubing
- Nylon
- Polycarbonate
- Stainless steel + polymer composites

Bioabsorbables

- PLGA
- PLLA
- PLG

Metal + Conductive Materials:

- Nitinol
- Stainless steel
- Gold
- Platinum
- Cobalt chromium

Glass

Specifications

Wavelength:	1552 nm
Energy/pulse:	5-50μJ
Pulse width:	800 fs
Avg. power:	5 watts

Ultrafast Athermal Lasers 101 (cont)

Collaboration Development Manufacturing

The Pulse of Innovation.

When the energy of lasers is delivered in pulses rather than waves, the strength of the electric field generated by the beam increases significantly; the shorter the pulse, the greater the intensity of the energy delivered. IntriMed's ultrafast athermal laser, also known as a femtolaser, generates light pulses that are measured in femtoseconds (10^{-15} of a second, or a quadrillionth of a second), versus CW lasers with pulse durations of more than one nanosecond (10^{-9} of a second, or one millionth of a femtosecond).

The ultrafast athermal laser pulses deposit energy so quickly that electrons are literally stripped from targeted molecules, causing material to be electrostatically ejected from the target while keeping surrounding material cool and thermally unscathed. As dramatic proof of this ability to cut without generating heat, scientists working for the military have used ultrafast lasers to machine high explosives without danger of detonation. And because only a very thin layer of materials is removed, the cut surface is very smooth and does not require post processing (Figure 4).

Polymers and bioabsorbables, which would melt when exposed to a CW laser, can be cut or drilled with the ultrafast laser to exacting tolerances (Figure 5); even individual cancer cells can be targeted for destruction without injury to surrounding, healthy tissue. Virtually any material – metals, high melting, transparent, organic, or inorganic - can be intricately machined (Figure 6) using IntriMed's ultrafast athermal laser.

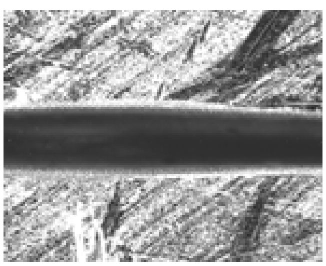


Fig 4. Ultrafast laser cut in stainless is clean w/no slag.

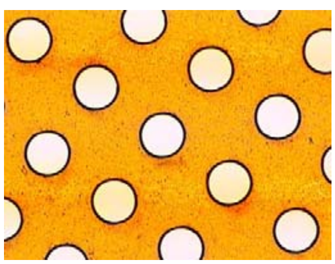


Fig 5. 200 μm holes in 50 μm thick polyimide.

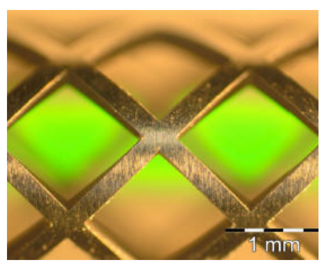


Fig 6. Stent pattern cut in Nitinol tubing with 250 μm wall.

Improving Efficiency. Enabling Breakthroughs.

As the demand for less invasive medical devices and procedures grows, entirely new manufacturing technologies are required to create the precise, micro-scale components made of advanced materials that comprise these miniaturized devices. At the same time, medical device manufacturers must find ways to manufacture these breakthrough devices more efficiently than ever before.

IntriMed's ultrafast athermal lasers address these demands for precision, quality and efficiency with technology that has moved from the realm of novelty and fantasy into an era of applications, arming device manufacturers with the capability to truly revolutionize patient care.

IntriMed At-a-Glance

Registrations + Certifications

FDA Registered
ISO 9001:2008 Certified
ISO 13485:2003 Certified
UL Registered

Capabilities

Design + Development
Rapid Prototyping
Microforming + Micromanufacturing
Precision Stamping
Low + High Volume Manufacturing
Athermal Laser Processing
Electrical Discharge Machining (EDM)
Overmolding + Assembly
Tool Design + Tool Making
Electrochemical Polishing (ECP)
- Pointing
- Deburring
- Polishing

Specialty Cleaning

Markets Served

Drug Delivery
Orthopedics
Interventional Therapies
Minimally Invasive Surgery
Ophthalmology
Neurology

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