

# Micro Laser Cutting in Jewelry Applications: A High-Tech Approach to Fine Detail

Advances in Jewelry Manufacturing Technology for Precision Cutting in Precious Metals

by Jay McCais, Product Manager • ROFIN-BAASEL, INC.  
with information from Paul Kochan • MICRO DIVISION, ROFIN-SINAR, INC.

Recent technological research and advances in laser application have turned the art of fine-cutting and micro detail into a reputable and highly successful procedure for the jewelry industry. Jewelry manufacturing for the 21st Century takes a “micro” step into huge options for detailed cutting in precious metals, alloys and steel.

This precision equipment has been specifically designed for micro-machining metals in jewelry production applications. Platinum, gold, silver and titanium alloys – up to 3mm thick – can be cut to the finest detail.

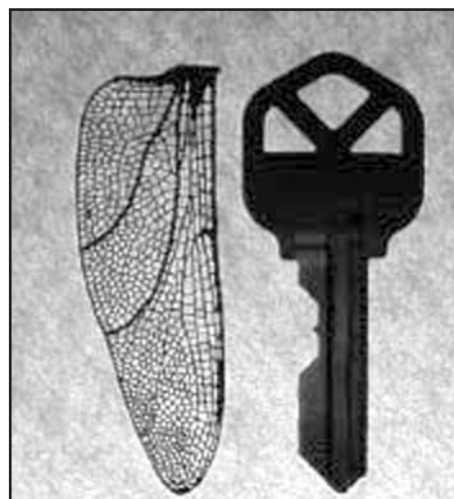
## Transition from Medical Technology to Jewelry Manufacturing

Pinpoint accuracy is necessary in creating the micro-sized components used in today’s modern medical technology. Rofin recognizes that the same technology benefits the jewelry industry, and because laser cutting is well suited to automation, the potential for repeatedly cutting fine detail in precious metal is a desirable outcome. The cutting laser opens the doors to infinite possibilities for the design once thought to be too complex for efficient manufacturing. The unique laser CAD software employed in the laser allows perfect replicas to be produced from a photograph or hand drawing – allowing the jeweler’s imagination, and the speed of light, to have complete control over the shop’s design capabilities. The YAG laser employed cutting system is optimal for fine cutting in metals, replicating intricate detail with precision and ease.

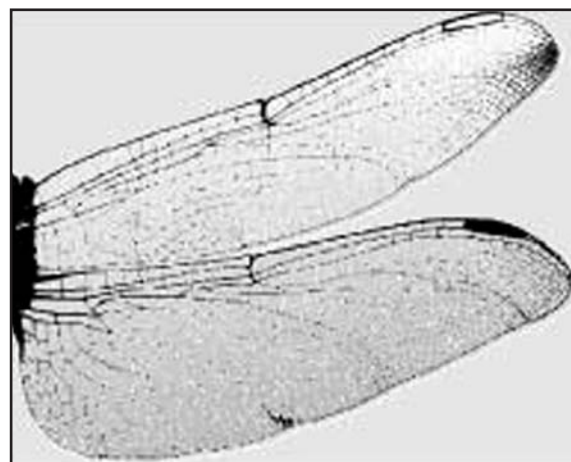
## Test Case: Platinum Dragonfly Wings

The project chosen to determine whether the tool would be appropriate for jewelry application was a recreation of a set of dragonfly wings in 2mm-thick, 99.5% platinum sheet. Platinum – a heavy and highly dense material – is harder to hand-work than other precious metals and requires a dedicated set of hand tools to prevent contamination to the platinum material. Craftspeople usually begin working with platinum

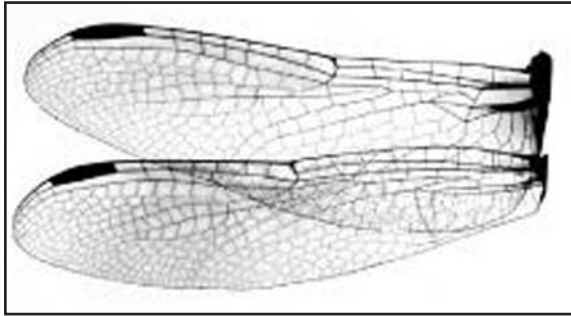
after they’ve gained experience in working with other precious metals. The special properties of the medium, teamed with the particularly detailed design, were deemed a challenging test of the cutting laser. The process began with a printed black-and-white hand drawing of the dragonfly wing. The hand drawing was



*The platinum wing, actual size (approximately 2.25”)*



*The original artwork: a color hand drawing scanned into a bitmap image and converted to black and white.*

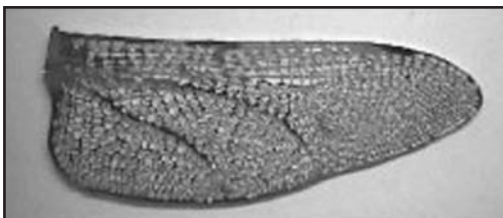


*Artwork converted to a CAD image, allowing the laser cutter to recognize dimension.*

scanned into a bitmap image. To create a motion control program for automated cutting, the picture was then converted from the bitmap raster format to a vector format. This was done using a standard off-the-shelf, raster-to vector converter program. The vector program allows the “ins and outs” within the design to be recognized for cutting. Next, using post-processing software, the vector drawing was converted to a machine code program to be used in driving the automated servo axis of the cutting table. The laser cutting workstation is designed so that the laser cutting head remains stationary during the cutting process; the cut geometry is achieved by motorized X and Y axis motion control of the cutting table. In this project the platinum sheets were held to the cutting table with adjustable pneumatic clamps. With the simple push of a button, the workstation then takes control to complete the precision cut. Cut times for simple geometrics such as name charms can be as short as 30 seconds. Because of the multitude of cut geometrics in the dragonfly wing, cutting time took approximately 24 minutes. Upon completion of the cut, the work pieces required little cleanup to be ready as finished product. This same work may have originally taken a jeweler more than two weeks to prepare, hand-cut and finish.

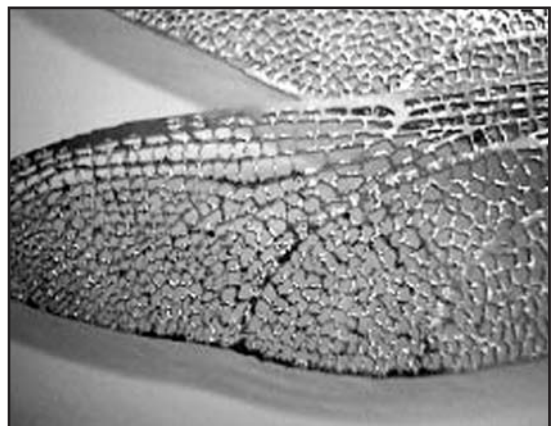
Manufacturing the most Intricate designs now become standard with the StarCut Performance.

The cutting laser makes simple work out of complex geometries, allowing the jeweler to manufacture a wide range of quality products including highly detailed pendants, charms and rings.

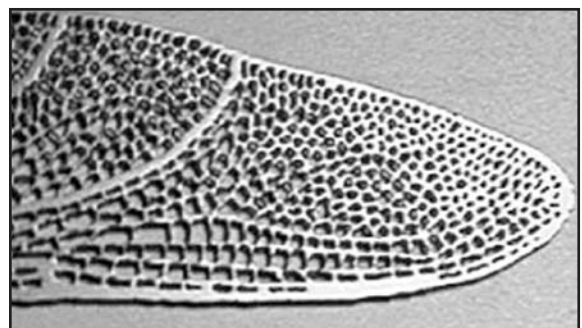


*Completed wing, cut in 24 minutes (actual size).*

- Finely crafted pieces that would have taken days or weeks to produce by hand can now be manufactured – again and again – in a matter of minutes.
- The unique laser CAD software allows perfect replicas to be manufactured from a mere photograph or hand drawing.
- Graphical User Interface allows fast and accurate parts processing of common graphic files to CNC cutting routines. Raster to Vector capability allows conversion of scanned files to the CNC cutting program.
- The fully automated, computer-controlled workstation gives one operator the ability to produce hundreds to thousand of pieces per day.
- The pulse repetition rate of the laser provides optimum performance for maximizing cutting speeds.
- Standard machine configuration accommodates flat-sheet cutting capabilities with optional motorized Z rotary axis control for added cutting configuration and automatic operation.
- Cuts thicknesses of up to 3mm (.12”).



*Completed wing design before polishing (enlarged).*



*Completed wing design after polishing (enlarged).*

## Fine Cutting with Lasers

Laser processing is often the best production technology for components made from small-diameter tube or flat sheet foils. The capabilities of different types of lasers are described.

### Reasons for choosing a laser

The continuing miniaturization of medical devices means that there is a fast-growing need for new production equipment capable of producing subminiature finished parts by cutting, drilling, ablation or etching. The laser is an ideal tool for many micro-sized components.

Today's designer can specify manufacturing by laser whether the material is hard or soft, and the non-contact nature of laser cutting allows the finest possible foils to be processed. Extremely fine features can be cut by laser and a high aspect ratio (narrow cuts in thicker material) is possible. For example, 18mm wide slots can be cut 100mm in thickness. The combination of laser cutting and a multi-axis precise cutting machine allows complex geometries to be easily processed, the accuracy determined by the quality of the motion system.

Fine processing of polymers is achieved using lasers of a different wavelength. Using a laser with a short pulse width can minimize the degree of heat affected zone (HAZ), which in turn reduces the amount of cleaning and polishing required after cutting.

Because the laser is suited to automation, it is easily integrated into turnkey systems and can offer a high degree of automatic operation, thus gaining maximum throughput of finished parts with minimum manual intervention. The reliability of automated systems means that unscheduled downtime is rare and in many cases where the laser cutting system is used in a three-shift regime, production time is greater than 98%.

In short, the laser is capable of finer precision than plasma or water jet, which have their own benefits in thicker materials, and the high aspect ratio and speed

offer distinct advantages compared with photochemical etching. Laser cutting is typically faster than wire erosion and can also be used in a wider range of materials.

### The capabilities of YAG laser

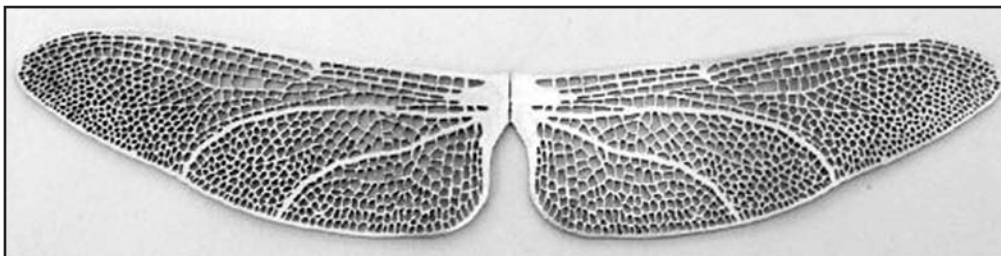
YAG lasers are used in cutting medical parts such as stents and other vascular implants manufactured from small-diameter tube. Small components can be made from flat sheet and if a five-axis machine is used, complex three-dimensional shapes can be cut in hemispherical or irregular-shaped parts. The YAG laser is used for drilling fine-holes in the manufacture of filters and surgical instruments and it can cut virtually all metals including those most commonly used in medical devices (stainless steel, platinum, gold and titanium).

### New technology in the pipeline

Laser technology is continuously moving forward and currently much development is taking place in lasers for manufacturing. Diode-pumped YAG lasers offer benefits in terms of improved optical efficiency and reduced maintenance. The laser flash lamp is replaced by a stack of laser diodes, which have longer life and higher efficiency. This should allow higher beam quality, higher power and faster processing with the same or better quality of cut.

Ultra-short pulsed systems are also being developed that can deliver pulses short enough to eliminate any thermal dissipation of the energy into the base material. This improves the quality of the cut and removes the HAZ in some materials by ablation rather than vaporization of the material, which is removed.

The Femtosecond laser (a femtosecond is one millionth of a nanosecond) is available on the market, although to date cost prohibits its use in many manufacturing applications because material removal is slow and capital is high. It can be predicted that the number of lasers used worldwide for micromachining medical devices will grow dramatically in the next five years.



*A pair of completed dragonfly wings in platinum, enlarged to show detail.*