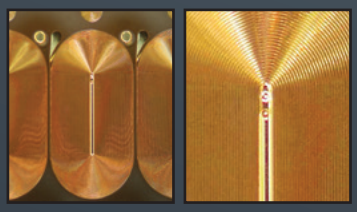
We *get* small.

Micron-scale Circuits and Structures
from Prototype through Production

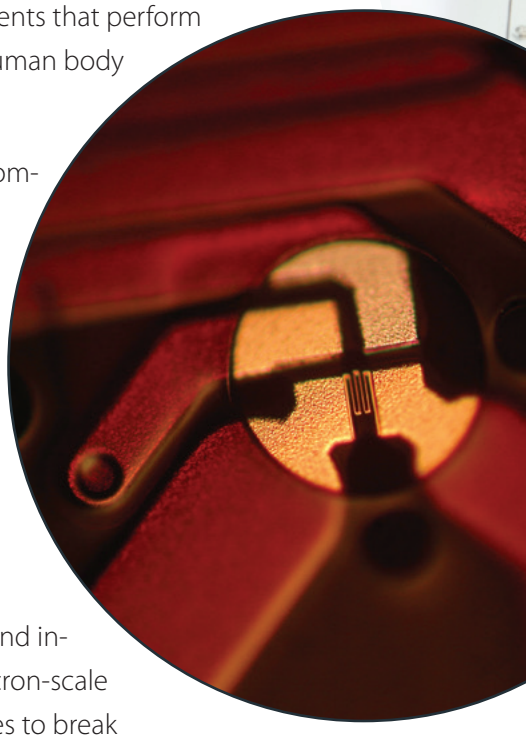
METRIGRAPHICS®

Smaller, tighter, better.



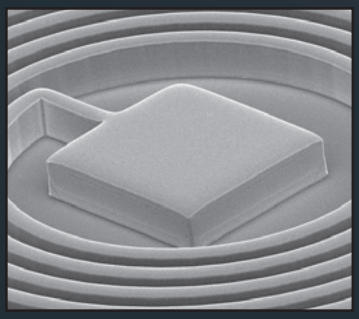
This complex copper micro-coil consists of four coils, each with 44 turns, layered one over another and series wound for a total of 176 turns per induction system and with an overall width of 2.3 mm (0.090") and length of 4.24 mm (0.167"). The conductor width is 12.5 microns (0.0005") and the spaces between conductors are also 12.5 microns. Conductor height is 7 microns (0.0003"). A 10-micron (0.0004") thick polyimide layer separates the four copper conductor layers.

When you need to produce ultra-small electrical, mechanical and optical components to extreme tolerances — components that perform under very adverse conditions, such as in the human body or in outer space — count on Metrigraphics.



We've been in business over 50 years, with customer relationships dating back over 20 — serving more industries and applications than anyone else at this scale of component miniaturization.

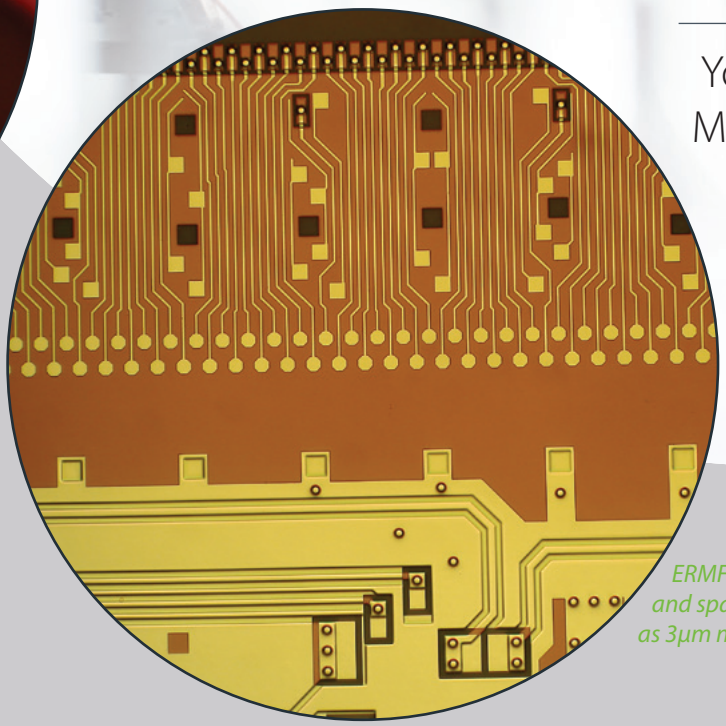
Our customers trust us to process develop, prototype and manufacture the smallest-size components at high yield — often beyond what's commercially available anywhere else. From 1-micron resolution photolithography to 5-micron patterned electroforming, to 200 Angstrom thin film processing, we continually find innovative ways to combine industry-leading, micron-scale technologies with our own proprietary processes to break through barriers of size, durability, reproducibility and lifetime performance.



Metrigraphics' electroforming technology can fabricate high aspect ratio conductors (they are tall relative to their length and width). This electron microscope image shows a coil on a glass substrate. The width of the conductors is 10 microns (0.0004"), and the height of the conductors is 25 microns (0.001"). The spaces between the conductors are also 10 microns. Dimensional tolerance is better than one micron.

You can't just "make it smaller."

Most components engineered to work at macro scale don't work at a 5-10 micron scale. Usually, they must be reinvented: to be manufactured in a new way, to function in a new environment, and to achieve a new level of electrical, mechanical or optical performance. Making a component this small is challenging — even after you have a successful design. What's critical is finding the process development talent to help you create that design in the first place. That's why you don't just get components from Metrigraphics. You get an innovation partner with unmatched skills, experience and resources for coming up with original and workable solutions to the most difficult "small" problems.



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ERMF circuits can be manufactured with traces and spaces as small as 5µm. Traces as narrow as 3µm may be achievable for some designs.

Rigid & Flexible Microcircuits

Using electroforming, photolithography and proprietary technology, Metrigraphics makes a wide variety of ultra-miniature circuits that achieve product design goals not possible any other way.

Products include:

- Single-layer flex
- Multi-layer flex
- Rigid circuits
- Sensor components
- Coils
- Electrodes (neuro-stimulation)

Using additive photolithographic processes, extreme resolution microflex (ERMF) circuits can be manufactured with traces and spaces as small as 5 microns. They can also be delivered in complex, high-resolution shapes and patterns. They are produced with very thin layers of sputtered metal or thicker plated metal such as gold or copper. For some designs we can achieve traces as narrow as 3 microns.

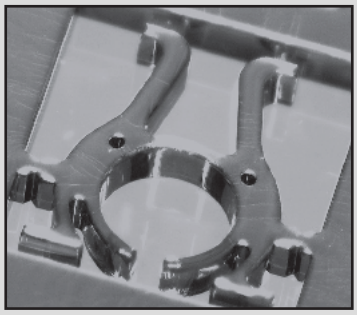
Applications for single-layer circuits include invasive medical devices and in-vitro diagnostics. Multi-layer circuits (up to six or more layers) include additional conductive layers that are independently stacked, aligned and interconnected. Plated conductive vias connect the different layers as required. Metrigraphics offers via sizes down to a 25 micron diameter.

Electroformed Structures

We use electroforming to create complex multi-level structures by controlling the electro deposition of metal passing through an electrolytic solution onto a conductive patterned surface called a mandrel. The mandrel can either be metal (such as stainless steel) or a metalized form (such as glass with a conductive cover).

Extremely fine geometries, tight tolerances and superior edge definitions are possible due to the pattern's high resolution. Furthermore, the geometric options are unlimited since a photoresist image forms each layer's xyz structural plane.

Because the mandrel surface can be replicated almost at an atomic level, electroforming has become a preferred process for fabricating micron-scale metallic components as well as for making injection molds used for forming nonmetallic microstructures with nano scale features. It is ideal for applications where low-cost and high-quality production is required combined with high repeatability.



Sample Applications

- Micro nozzles
- Microstructures
- Slits
- Micro screen / mesh
- Disks
- Embossing tools

Commonly Used Materials

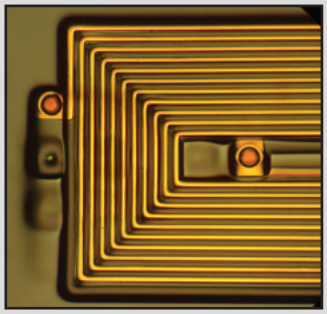
- Nickel cobalt
- Pure gold
- Hard gold
- Copper
- Nickel
- Platinum

Precision electroforming can create microstructures such as single-level, precisely formed needles with 0.005mm x 0.005 mm square cross sections. Complex, multi-level microstructures can be formed with the same precision as single-level structures. Multi-level structures may be free standing or connected to comb-like supports to facilitate handling or fixture mounting. More complex, single-wall, hollow needles are also possible with precision electroforming.

Ultra-fine geometries in metal (e.g. 2 micron holes) are now available by electroforming to a glass mandrel as in these 40-microns-thick nickel cobalt samples over-plated with gold.

Biocompatible Component Expertise

Biocompatible components for implantable and contact medical devices are a significant application for our multi-layer flex circuits and electroformed structures where size, bend radius, structural loads and non-reactance with body fluids are critical factors. Feature size is 3-10 microns.



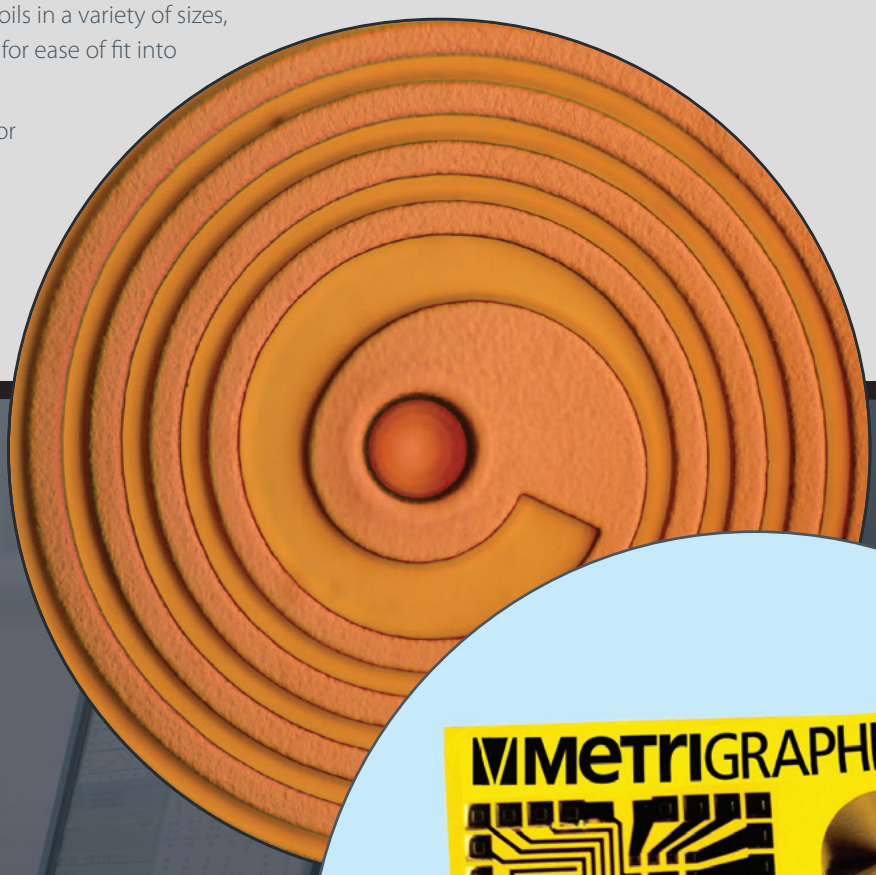
Applications include:

- Glaucoma shunts
- Blood chemistry sensors and measurement devices
- Electrical interconnects for catheter devices
- Neuro-stimulation probes and electrodes
- RF induction coils and antennas
- Optic nerve and retinal implant devices

Where wireless power or RF signal transmission is required, our ultra-miniature coils eliminate the need to pass power and control wires through the body. Coils are available with individual traces as small as 3 microns.

Coil Capabilities:

- Single-layer, multiple-turn electroformed coils in a variety of sizes, and round, oval and square configurations for ease of fit into specific applications
- Multi-layer coils with greater field density for more high-end applications



Bend radius, structural loads and environment play an important role in many ultra-miniature circuit applications. Here, a Metrigraphics flex circuit wrapped around a pencil demonstrates the ability to achieve a small radius of curvature — especially important in medical devices. Small circuits often must be rolled and inserted into a catheter, for example, to attach a test device to connecting cables.

Optical Component Expertise

For more than 50 years we've been a trusted supplier of precise optical components for motion control, analytical instrumentation, test and other optics markets — all designed and manufactured to impossibly high standards of precision and reliability.

Our optical components include rotary disks, linear encoder scales, reticles and test targets.

Combining our core technologies of photolithography and thin film coating with our proprietary processes, we achieve the highest degree of edge definition in rotary disks and encoder scales with line-width tolerances of 1 to 2 microns. Disk positional accuracies of a few arc seconds and scale accuracies of up to 1 micron in 12 mm are possible in scales with lengths of up to 2 meters. To verify disk accuracy and confirm light transmission variation, we offer D.C. electrical testing and harmonic testing.

We also combine our core technologies of photolithography, thin film coating and electroforming to fabricate precision optical reticles with optimum accuracy, repeatability and precision. Materials include glass, quartz, metal and flexible polyimides.

For test targets we fabricate a variety of standard 1951 USAF and custom target designs using our advanced optical coating process. These include standard and high-resolution designs for testing optics, instrumentation and processes. Our extremely durable patterns are typically created with thin-film chrome, although we're also skilled with a number of other materials, available upon special request, such as gold, copper and nickel. We can apply targets to nearly any material, including: soda-lime glass, ceramics, quartz, silicon wafers, polyimides and plastics.

Rotary Disks and Linear Encoder Scales

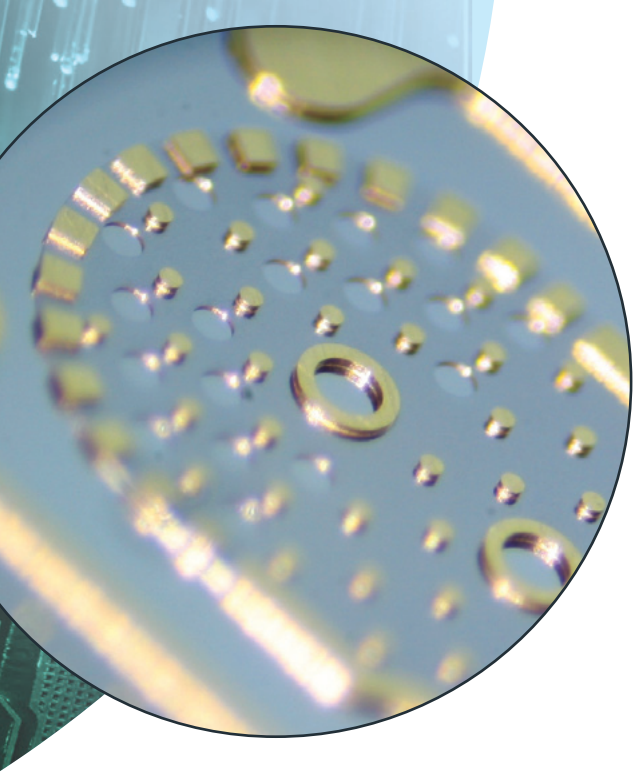
- Computer peripherals
- Motion control
- Space & defense
- Testing
- Medical
- Analytical instrumentation

Reticles

- Space & defense testing
- Analytical instrumentation
- DOD projects, slits in spectrometers
- Tank-sight reticles
- Microscope reticles
- Targets used to calibrate complex optical systems and x-ray systems

Test Targets (for testing of):

- Optics
- Instrumentation
- Processes



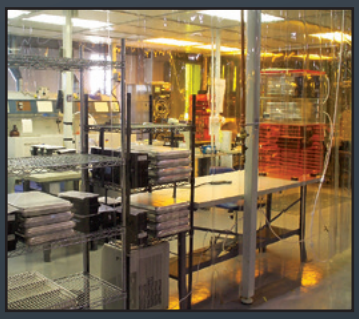
We get small better than anyone.

Metrigraphics is unmatched when it comes to design assistance, prototyping and mass-producing micron-scale components that combine ultra-miniature feature size, tight tolerances and high reliability, even in harsh environments. We get small better than anyone. And no one else has become more practiced at it or has done it in so many ways — as evidenced by our breadth of applications in markets that include medical, BioPharma, photonics, motion control and computer hardware and peripherals.

Designing an ultra-small part doesn't help if you can't produce it reliably at high volumes and at an affordable cost. We develop the process — from one prototype to tens of thousands devices per week.

Proven Metrigraphics Success:

- Over 13 million sensors for large medical technology OEM
- 18 years of nozzle plates for Lexmark desktop printers
- Developing nozzle plates for next-generation high-end large format printers
- Military optics and circuit applications
- Added platinum plating for medical market
- Added palladium for sensor market
- Working with specialty glass for optics markets



What we offer:

- A 50-plus-year reputation for impeccable product quality and customer satisfaction
- Feature sizes as small as 1 micron
- Up to 6 metal layers and more
- A 40,000-square-foot facility that includes:
  - Laboratory, office and production space
  - 11 class 1000 clean rooms
  - 3 class 100 clean rooms
  - 3 plating areas
  - 7 sputtering systems
  - 3 ion-beam milling systems
  - 3 Suss mask aligners
  - Separate production and development areas and equipment

ITAR REGISTERED

REGISTERED ISO 9001:2008

Call us when you need:

Circuit features down to 5um

Pinhead-size, implantable biomedical electronics

2-5 micron-size holes in nozzles, filters, masks, to other components

1-2 micron line accuracy in optical components (like encoders or grids)

Flexible circuits with 5 to10 micron features that can be wrapped around .060" diameters

An original solution in the design and manufacture of ultra-miniature components

Contract services

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