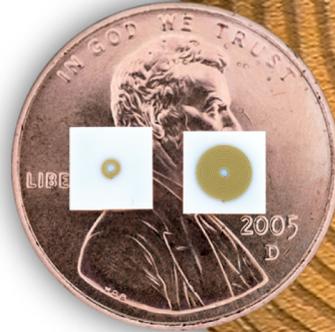


Think Little, Dream Big

Sandia's Metal Micromachining Program

Sandia National Laboratories' Metal Micromachining Program specializes in the fabrication of small innovative devices. Through a consolidated, in-house capability, unique products are created using advanced, nontraditional processing of exotic and diverse materials. With expertise in the fabrication of thick, high aspect ratio uniform metal and metal alloy structures too small for traditional machining, the Program maintains a suite of tools and capabilities that transform big ideas into little devices.

The Metal Micromachining Program leverages three core capabilities—fundamental science, process development and product realization—to produce devices without the inherent limitations that exist in other approaches. Its technologies have been applied to diverse fields including quantum computing, photovoltaics, kilohertz waveguide development, nuclear magnetic resonance imaging and phase contrast imaging. Exceeding beyond simple chemistry and molding, the Metal Micromachining Program employs an exacted flow dynamics process to fabricate devices with the highest degrees of accuracy and precision to ultimately meet a broad range of national security needs.



Metal Micromachining Program

Core Capabilities

Micromachining research, development and fabrication of this nature require a well-developed suite of core enabling capabilities. The Metal Micromachining Program offers a unique environment which combines expertise, facilities and equipment necessary to dynamically build upon the area both through theory-based exploration and fabrication of functional devices.

FUNDAMENTAL SCIENCE:

Electrochemical research and development (R&D) and engineering serves as a theoretical and practical basis for the Metal Micromachining Program. The study of electrochemical phenomena and use of analytical techniques provides a powerful set of tools to analyze and formulate precise and optimized plating conditions. This is required to realize unique combinations of metallic alloys with tailored crystallographic orientations and made-to-order grain sizes.

PROCESS DEVELOPMENT:

The Metal Micromachining Program maintains three fabrication labs dedicated to process development. The Program is capable of performing full-spectrum fabrication, as well as partial steps of the fabrication process on an as-needed basis. Also, access to comprehensive fabrication laboratories and equipment allow proof of concept experiments to be performed (as a controlled environment is required to develop and maintain customized processes). The ability to deviate from traditional methods and develop new processes allows the team to continually push the limits of what can be achieved.

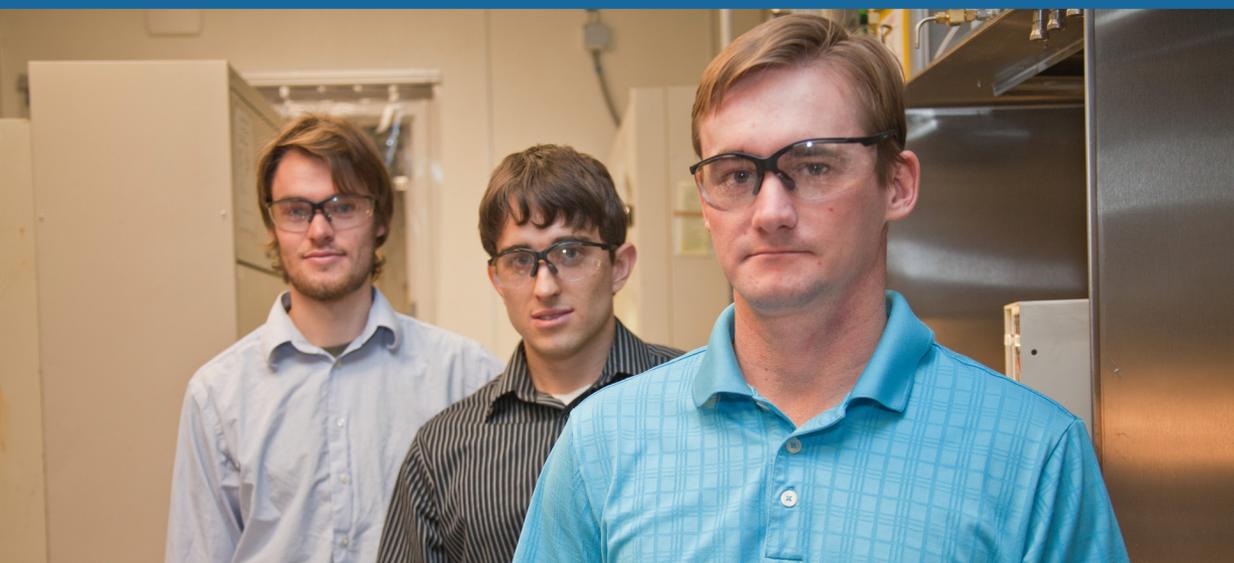
PRODUCT REALIZATION:

Limited only by the current periodic table, the Metal Micromachining Program produces functional coatings and high aspect ratio 2.5D electroformed structures too small for traditional machining. With structures ranging from micron to millimeter scale, ultra-thick lithography, electrochemical deposition and precision planarization can be used to alter devices' physical properties through the application of precise metal coatings or to form structures on virtually any planar or semi-planar surface. This specialized capability allows the team to help customers develop, design and fabricate innovative, even unusual, products never-before thought possible.

OUR LABS:

The Metal Micromachining Program maintains three state-of-the-art fabrication laboratories to produce cutting-edge, high-quality metal devices too small for traditional machining. Equipped with the a vast collection of hardware, materials and programs, each laboratory can be used to perform both traditional and nontraditional work. Whether your project requires a unique, custom-designed mold or bottom-up electroplating, the Metal Micromachining Program's has the facilities necessary to get the job done.

	LITHOGRAPHY	ELECTROPLATING & CHARACTERIZATION	PLANARIZATION
SPECIFICATIONS	<ul style="list-style-type: none"> • Class 100 clean room • Several fume hoods and wet benches • Ultrasonic and megasonic agitators • Exposure stations 	<ul style="list-style-type: none"> • Wafer— approx. 2 gallon • >20 linear fume hoods • >12 plating tanks • Baths equipped with in-line filters, heaters, and pumps • All tanks are 6" to 8" compatible • Baths designed to accommodate 3D parts • Profileometer • X-ray fluorescence (XRF) spectrometer • Nano Spec • Diffusion bonder • Electroplating chemistries include nickel, copper, gold, platinum, and indium, among others • Offers a few different magnetic materials, magnetically insulating material, several thermoelectric alloys, and electroless chemistries 	<ul style="list-style-type: none"> • Polishing wheels (hard to soft) • Chunks and mounting techniques can accommodate 6" diameter wafers • Diamond bit polishing slurry (30 microns - 1.10 of a micron)
APPLICATIONS	<ul style="list-style-type: none"> • Thick and encapsulated resist removal • Substrate etching • Membrane fabrication • Resist spinning • Alignment • Baking • Exposure 	<ul style="list-style-type: none"> • High aspect ratio, uniform electrofilling • Electroforming 	<ul style="list-style-type: none"> • Substrate thinning (bulk removal - fine polish) • Dye-level polishing
WHY IS SANDIA UNIQUE?	<ul style="list-style-type: none"> • Custom-designed molds • Clean room located outside the micro-fab allows development and maintenance of customized processes 	<ul style="list-style-type: none"> • Fill molds bottom-up • Exacted flow dynamics • Wide variety of metals on hand • Small footprint • Ideal anode to cathode ratio • High uniformity (flow and temperature) • Custom-designed electroplating baths 	<ul style="list-style-type: none"> • Diamond paste • Design of wheel line prevents cross-contamination



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