



# SolaFab, Femtosecond Desktop Micromachining Workstation

Clark-MXR, Inc.  
7300 W. Huron River Drive  
Dexter, MI 48130, USA  
1(734) 426-2803  
sales@cmxr.com | [www.cmxr.com](http://www.cmxr.com)

## SolaFab, Desktop Femtosecond Micromachining Workstation

SolaFab is a femtosecond fiber laser-based desktop micromachining workstation for R&D and smallscale production environments. SolaFab is based on OEM-ready Solas-Series family of fiber lasers. This

is a Class-IV laser embedded Class-I laser instrument that can be utilized in a research laboratory to

R&D and prototyping environments to small scale production runs. The entire workstation fits in a supplied 36"x 72" table with all the parts and electronics contained within the same footprint to maximize the floor space utilization.

SolaFab is a direct result of 20+ years of providing femtosecond lasers and femtosecond laser-based micromachining workstations for research and production entities and our accumulated know-how on providing micromachining services to many industries, including semiconductor, medical, metrology aerospace and automotive. SolaFab comes with this experience as the backbone and with sales and service support from engineers and scientists who are involved in providing contracted micromachining services on a daily basis.



### Unique features of SolaFab

All-in-one architecture with built-in OEM-ready fiber laser

SolaFab is built on a manufactured solid surface-base with the fiber laser attached to the back of the

base. The laser beam is completely contained inside the enclosure until it reaches the sample. The entire workstation and controller electronics are built into a single table with 36"x72" footprint with single electrical connection.

### Adaptive MEMS mirror scanning

SolaFab utilizes a unique MEMS scanning mirror that can provide approximately 0.7mmx0.7mm scan

area where small drilling or milling can be performed. This mirror can also be used for beam manipulation other than scanning where the beam can be deflected to compensate for taper to simulate precession machining. This scanning mirror can also be used for wider cut widths or fills for applications like thin film ablation.

### 3-Axis motion system

SolaFab comes with XY motorized stage with 150mm<sup>2</sup> sample area and also motorized Z-axis optical

bench with fixed focal distance for in-line vision.

### In-line vision

Integrated in-line vision with LED lighting comes standard and this is built into Z-axis with fixed focal

length where one can approximate the machining depths without taking the sample out for measurements.

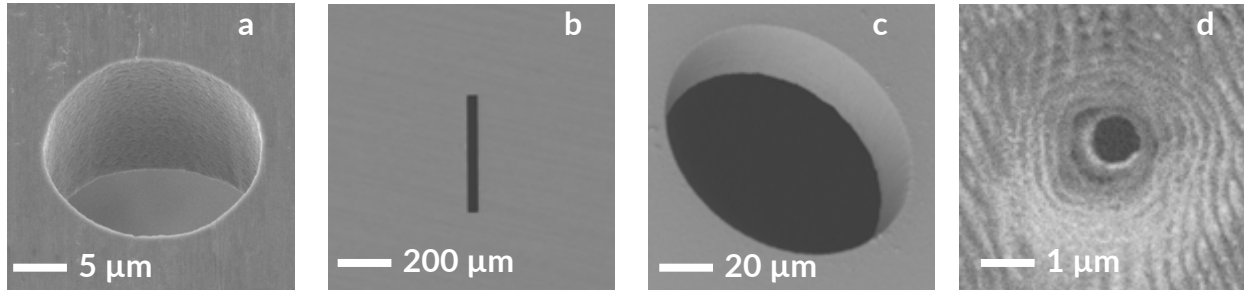
### Class-I certified

SolaFab is a Class-IV laser embedded Class-I laser product. The workstation is equipped with redundant interlocks and other safety measures according to CDRH guidelines.

## Applications

### Micro drilling

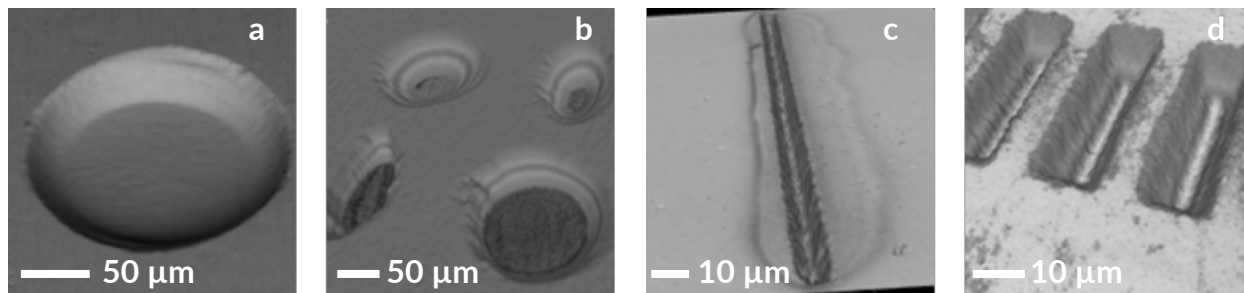
Micro drilling for through hole drilling or any other application can be done with SolaFab. The side walls can be straight or tapered depending on the desired outcome and material thickness and can drill or cut various foils with no heat affected zone (HAZ). The below example shows apertures and slits that were done with SolaFab on metal substrates.



a. 30µm hole in 50µm thick molybdenum b. 50µm wide optical slit in stainless steel c. 100µm hole in quartz d. sub-1µm hole in stainless steel

### Micro milling / Controlled defects generation

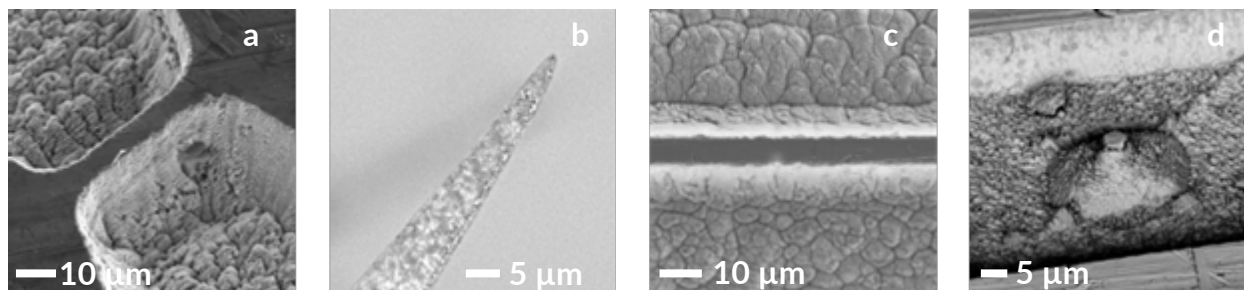
Micro milling can be utilized for various different applications. SolaFab can mill down samples with virtually no heat affected zone and thickness down to 5 microns or less. Another application is to make counter sunk areas or pockets to machine through holes or slits with narrow opening from 1 to several microns wide.



a. Blind pocket in a metal sample. b. multiple blind features. c. Controlled wear defect for visual comparison identification under microscope. d. Series of controlled wear defects for failure analysis

### Electron Microscopy Sample Preparation

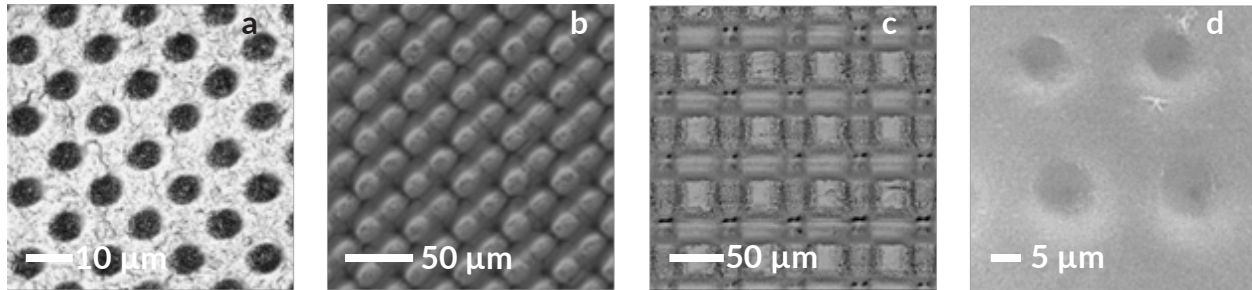
One prominent application is to make samples for electron microscopy by milling down samples to few microns thus saving time on the focused ion beam which is expensive and time consuming. This can be a very thin slice of a sample without collateral damage to the adjacent area or a micro needle with dimensions as small as few microns with no heat-affected zone ready to be final preparation with focused ion beam milling



a. H-bar machined into metal sample with ~5µm ridge width. b. Micro-needle in a metal samples for electron spectroscopy. c. 5µm wide sample section ready for final prep with FIB d. Pillar (pyramid) machined in a metal sample.

### Surface structuring

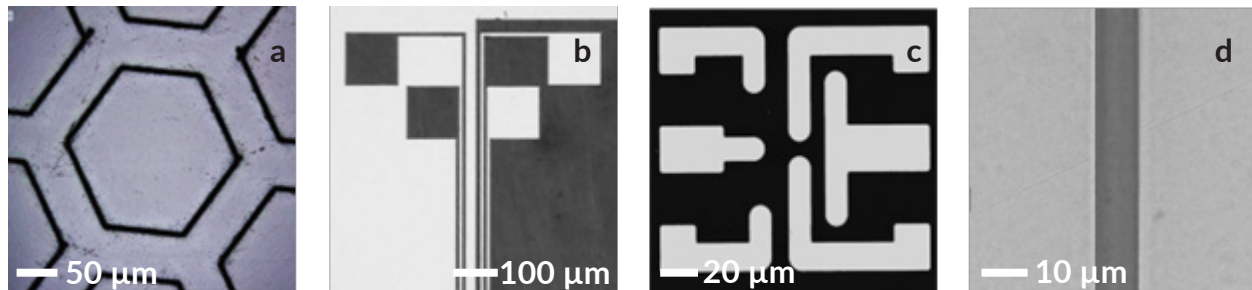
Surface structuring with femtosecond pulses has its advantages due to the “athermal” nature of ablation. This can increase the surface area for heat dissipation or enhanced adhesion of coating agents with no chemical changes to the substrate.



a. 8um dimples in gold coating for better adhesion b. & c. Surface structuring on copper for heat dissipation d. 5um hole dimples in glass

### Thin film ablation

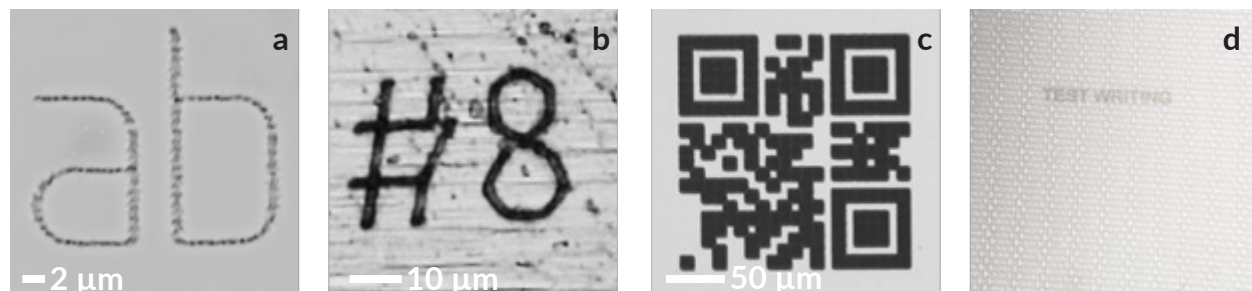
Whether it is a biological application for miniature electrode or for a shadow mask, SolaFab can be utilized for selectively ablating thin films. Depending on the thickness of the thin film, it can be ablated without damaging the substrate or another layer that is underneath in a stacked thin film assembly. This selective, depth defined ablation can also be used to remove deposited materials off of optics or any other substrate without damaging them.



a. 8um dimples in gold coating for better adhesion b. & c. Surface structuring on copper for heat dissipation d. 5um hole dimples in glass a. Flex structuring on SolGel compound. b. Micro electronic circuit on a metallic thin film. c. Shadow mask, sputtered metal on glass d. Thin-film ablation for electrode application

### Critical Surface Marking

Critical surface marking for identification and prevention of counterfeiting is an area where near invisible marking with no collateral damage is required. Whether the item to be marked is a precious piece of expensive jewelry like diamond or precious metal or a critically important piece or component of machinery or a medical or surgical instrument, SolaFab can be used for any of these marking requirements.



a. Marking example – invisible to human eye w/line width of 1um. b. Marking on precious stone. 2um linewidth and only visible at 20x magnification. c. A 150um x150um QR code marked on a metal surface d. Marking on a biocompatible medical fabric

### Standard Workstation Specifications:

<b>Laser</b>	Solas-Micro air-cooled OEM laser Wavelength: 1035±5nm Pulse energy: up to 2uJ Pulse duration: sub-200fs Rep rate: 200kHz
<b>Scanner/Objective</b>	MEMS Scanning mirror <ol style="list-style-type: none"> <li>1. 20x objective 0.7mmx0.7mm scan area 2um spot size, 20mm working distance</li> <li><b>OR</b></li> <li>2. 10x objective 1.4mmx1.4mm scan area 4um spot size, 30.5 mm working distance</li> </ol>
<b>Motion Control</b>	XY 150mm travel direct-drive linear stages Accuracy (calibrated): ±4µm Bidirectional repeatability: ±2µm Straightness/flatness: ±8µm 100nm encoders
	Z 100mm travel ball-screw stage w/brake Accuracy (calibrated): ±1µm Bidirectional repeatability: ±1µm
<b>Vision</b>	In-line, Live-view video feed LED illumination
<b>Construction</b>	Manufactured solid-surface base Table with built-in instrument cabinet Push-pull debris removal
<b>Enclosure/Safety</b>	Class-I enclosure with Safety interlocks Emergency stop and laser/machining status tower indicator Custom software package
<b>Facility/utility</b>	Installation location requirements: Environmentally stable condition including stable temp (within ±2°C) and stable humidity (±5% RH) with relatively dust free and vibration free environment Electricity: 110V dedicated circuit Compressed air/nitrogen for debris removal

## Options & Upgrades to choose from:

### SHG Configuration Option

*This option configures the entire system for SHG operation (no access to fundamental wavelength). Expected SHG conversion >30%. This option provides material specific advantages, negligible, sub-micron heat affected zone and smaller spot size.*

### Stages upgrade

*This stages upgrade provides following specifications for XY stage system.*

*10nm encoder*

*±0.4µm bidirectional repeatability*

*Accuracy (calibrated): ±1µm*

*±4µm straightness and flatness*

### Adjustable Rep Rate

*This option allows the user to adjust the repetition rate between 50kHz and 1MHz (Rep Rate: 50kHz<~26MHz/n>1MHz)*

### Pulse Picker

*This available pulse picker allows the pulse control within the selected maximum rep rate down to single pulses*

### Switchable fundamental/SHG

*This option allows the user to switch between fundamental and SHG wavelengths with a common set of optics. This option is ideal for R&D works that can utilize both fundamental and SHG wavelengths for their respective advantages.*

### Active depth measurement unit

*This option adds a dynamic depth measurement unit to the Z-axis for real-time, closedloop depth measurement and control.*

Delivery time: 6 months after PO. Includes installation and 2-days of training.

All of our systems include a 1-year warranty and on-site installation/training free-of-charge. Longer Extended Service Plans can be purchased to further protect your investment.

**Note:** Due to Clark-MXR, Inc.'s continuous product improvements, specifications are subject to change without notice. For more information, please contact us at [sales@cmxr.com](mailto:sales@cmxr.com) or visit us at [www.cmxr.com](http://www.cmxr.com).



## Clark-MXR, Inc.

We are a Michigan based corporation founded in 1992 and located just outside of Ann Arbor in the city of Dexter. We provide micromachining workstations and services, based primarily on ultrashort-pulse laser technology, to many different industries including medical, semiconductor, automotive, and scientific research. In addition, we develop and manufacture ultrashort-pulse lasers and were the first ultrashort-pulse laser company in the world. At the heart of each of our laser machining stations is one of our own lasers. Complete control and understanding of the laser provide us a unique advantage to manipulate and control the source in ways that allows otherwise unfeasible machining.

With proliferation of femtosecond laser-based micromachining research in 1990's Clark-MXR, as a femtosecond laser company with numerous inventions in the field of ultrashort pulse lasers, we took the initiative to develop femtosecond laser-based materials processing. This culminated in our first public demonstration of femtosecond laser machining in 1997 at the Laser World of Photonics in Munich, Germany.

### Our Capabilities

Here at Clark-MXR, we manufacture and service our own ultrashort pulse lasers and machining stations. Using these and other complimentary products, we provide workstations, contract machining and value-added services to a variety of industries that require no compromise, high-precision components. We have more than 20 years of machining know-how with many different materials including metals, dielectrics, crystals and polymers. We specialize in machining difficult to machine materials as well as cleaning, handling, and packaging of extremely small and delicate parts.

We also have an in-house Class-100 cleanroom for inspection and packaging of delicate and critical environment parts. We have a host of metrology tools including SEMs and a 3D laser scanning microscope. We can provide pre- or post-processing of components such as plasma cleaning, electro polishing, lapping, and micro-bead blasting when needed.

### Workstations and Custom Developments

We have been developing micromachining workstations since 1997 using our own femtosecond lasers. These systems can be standard configuration or purpose-built and optimized for customer requirements. We manufacture two different laser product lines, one based on solid-state titanium-doped sapphire (Ti:Saph) and the other one on Yb-doped fibers. Either of these sources can be coupled with Galvanometer mirrors, polygon scanners, multi-axis positioning stages, or any combination to handle the most complicated tasks.

### Prototyping and Process Developments

We have accumulated a significant amount of know-how since 1997. We have applied this knowledge to solving manufacturing problems in many industries and continue to work with customers to develop processes for the manufacture of unique samples and R&D parts that can be transitioned into production processes. You can utilize our vast knowledgebase for your own machining needs. Please email us at [sales@cmxr.com](mailto:sales@cmxr.com) or call us at 1(734)426-2803 to discuss how we can help.

