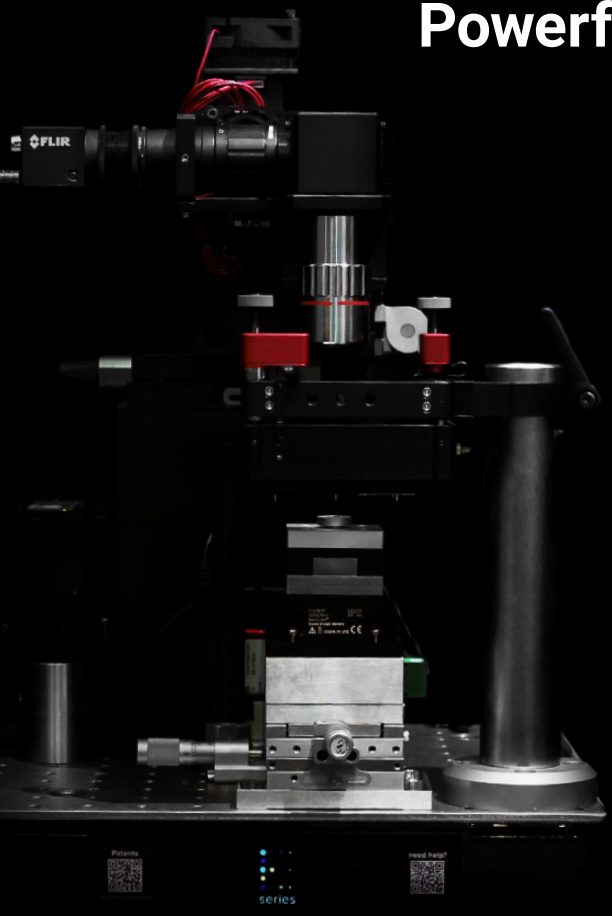
TERA-Fab®

series 2.0

TERA print

Introducing a New and Powerful Way to Nanofabricate



Prototype and manufacture nanostructured surfaces and devices faster and cheaper than ever before with TERA-Fab® E series 2.0 – the world's most advanced desktop nanoprinter.

DIFFRACTION LIMIT BREAKER
Fabricate with micro-to-nanoscale, sub-250 nm resolution.

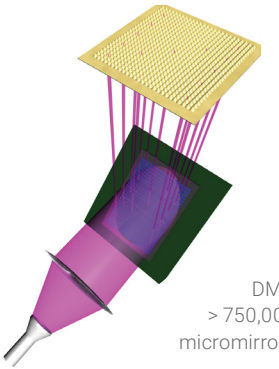
PARALLELIZATION MAESTRO
Write with 10,000s to 100,000s of micro-to-nanobeams in parallel, each acting independently over cm^2 areas.

MATERIALS PRODIGY
Access a wide spectrum of chemistries with dual-wavelength illumination (365-530 nm range).

USER ALLY
Start nanofabricating after only a few hours of training and without cleanroom constraints.

Unlock New Capabilities with Beam Pen Lithography (BPL)

BPL is a highly parallel and mask-free photolithographic approach that overcomes the diffraction limit and enables the rapid creation of arbitrary patterns over cm^2 areas with feature resolution down to 250 nm.



DMD
> 750,000
micromirrors

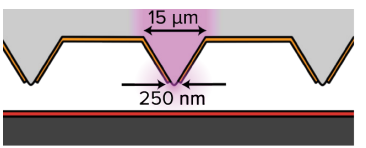
The E series 2.0 instantaneously transforms light from high-power LED sources into patterns of any design with the pixel size ranging from a few to tens of microns using an integrated digital micromirror device (DMD). A key innovation of BPL is the two-dimensional array of pyramidal-shaped nano-apertured tips located within the light path that further focuses light from the micromirrors and allow users to perform near-field photolithography with sub-diffraction resolution using 10,000s to 100,000s of independently addressable probes.

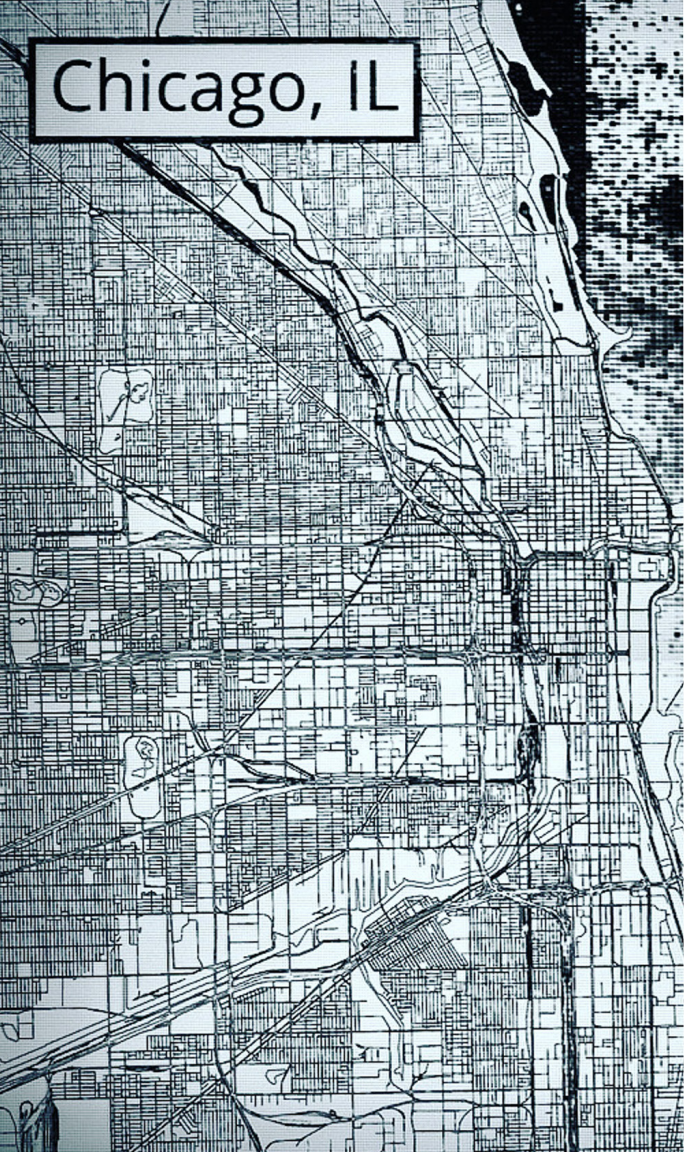
Featuring a dual-wavelength light source design and dynamic illumination correction over the entire field of view, the E series can be confidently used to rapidly prototype and manufacture functional micro- and nanostructured surfaces and devices using a wide spectrum of photochemistries and materials.

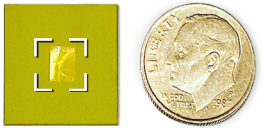
Applications include microfluidics, sensing, micro- and nanoelectronics, wearables, tissue engineering, highly localized and parallelized photochemistry, and many more.

Massively parallel BPL tip array with millions of tips

< 250nm resolution



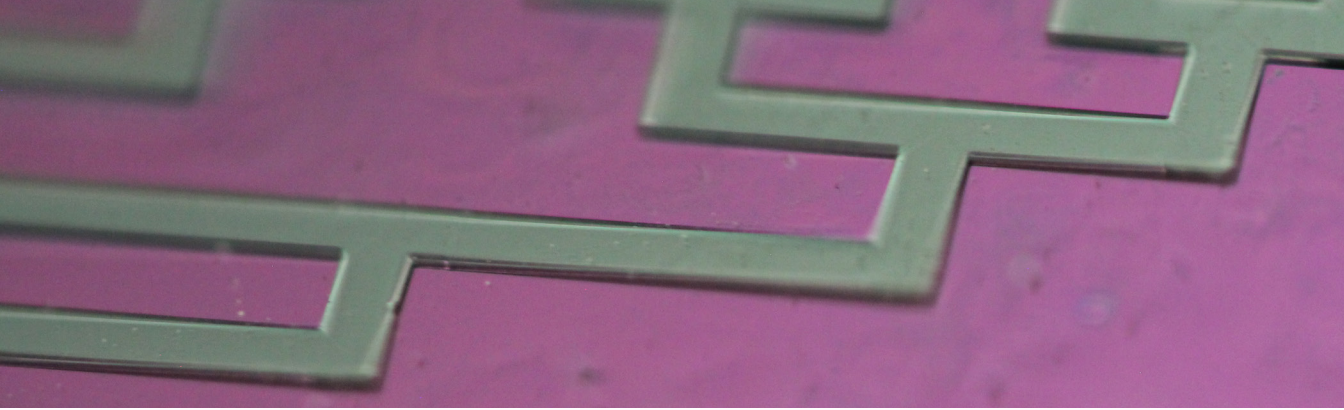




One Instrument. Many Applications.

The highly adaptable E series unlocks the power of rapid nanostructured prototyping and manufacturing across many fields.

Pattern made with S1805 Resist
Average feature size of 800 nm
Patterning time of 30 minutes
6.75M total features
Projection area of 5.12 mm x 3.84 mm



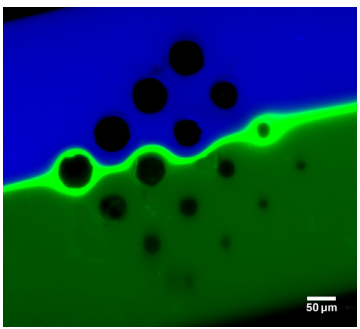
Fabricate SU8 master molds for microfluidic devices using DMD projections directly, or via BPL.

USE CASE 1

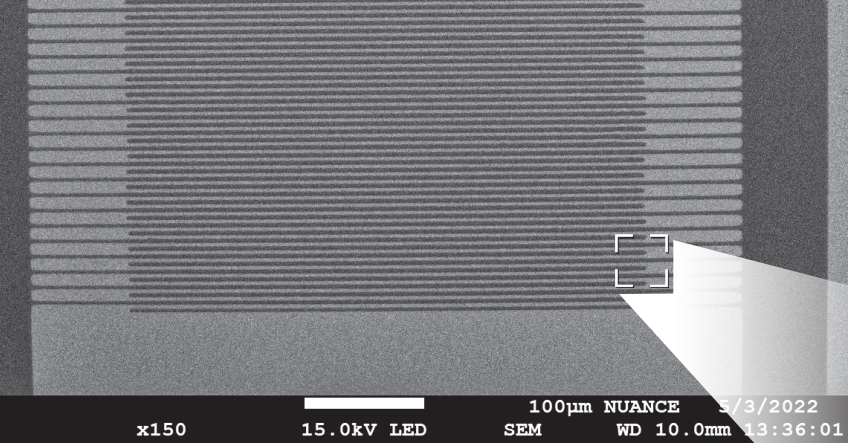
Rapidly Prototype Advanced Microfluidic Devices

With the E series 2.0, users can quickly transform a conceptual microfluidics design to a functional device, optimize the geometry and chemistry for a given application, and advance a prototype to production.

Fabricate mm-to-cm-scale devices with microscale resolution using maskless DMD-based photolithography, or push the limits into the nanoscale with BPL – it's as easy as uploading a digital mask and hitting 'go'. Take the same industry-tested standard photoresists you've wrestled with in the cleanroom into the comfort of your own lab.



Create functional microfluidic devices for mixing chemicals, cell storing, microemulsions, and much more.

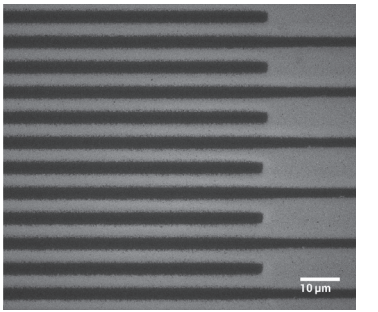


USE CASE 2

Create Complex Micro- and Nanoelectronic Circuits

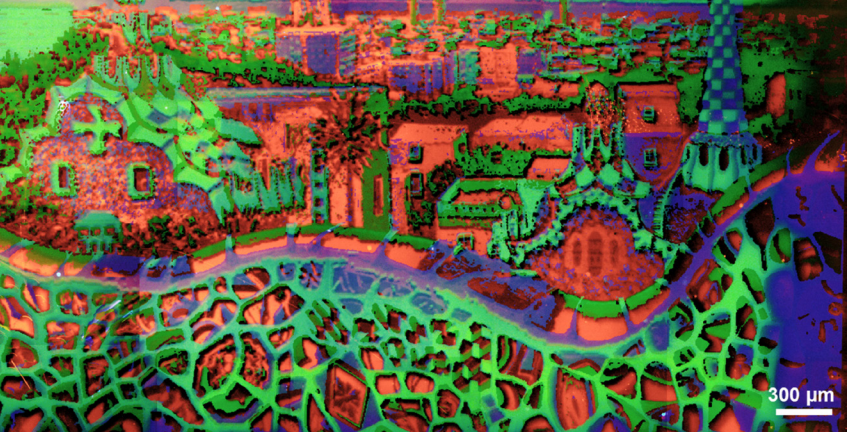
Create electronic devices from sensors to actuators of any design and functional elements ranging in size from 100s of nanometers to tens of micrometers via maskless DMD-based photolithography, BPL, or a combination thereof.

Fabricate with a wide spectrum of photosensitive materials, including conventional photoresists and conductive hydrogels, on hard and flexible substrates and make devices from wearable sensors to electromechanical micro-actuators with superior performance.



Fabricate interdigitated electrodes (IDEs) for sensing or develop micro- or nanoelectronic devices for other applications.

In this example, we demonstrate the fabrication of IDEs for sensing applications, which can be made using metal or carbon-based materials on flexible or rigid surfaces.



Create complex composites of biologically relevant materials, such as extracellular matrix (ECM) polymers and synthetic analogs, proteins, oligos, carbohydrates, and lipids.

Carbonell, C. et al, Nature Commun., 2020, 11, 1244

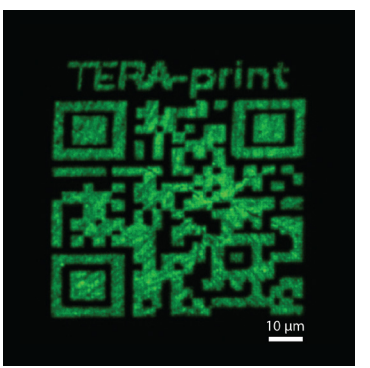
USE CASE 3

Bioengineer Like a Pro

Unlock high resolution in biofabrication and pattern biomaterials such as oligonucleotides, proteins, and hydrogels with the resolution down to 100s of nanometers.

Fabricate complex cellular microenvironments with precisely tuned local mechanical and chemical properties, in situ synthesize complex chemical microenvironments inspired by nature, or build artificial smart devices and systems with biology from scratch.

Design cellular microenvironments by conjugating proteins or other bio-molecules into hydrogel networks at sub-cellular resolution.



TERA-Fab® E series 2.0

Beam Pen Lithography (BPL) Nanofabrication System

HARDWARE

MOTORS / STAGES

Piezoelectric Motor (X-Y-Z)
Move sample in X-Y-Z directions over 100 µm with sub-100 nm resolution using cutting-edge piezo motion technology.

Tip/Tilt Alignment
Angular Range: ± 3.5˚ / Resolution: 4×10-5 deg. (0.7 µRad)

With a highly precise tip/tilt stage and a proprietary feedback mechanism, the BPL tip array and sample are automatically aligned down to 0.002˚ accuracy to yield a perfect pattern every time.

OPTICS MODULE STAGES

Focusing / Alignment (X-Y-Z)
Move the optics module over 35 mm in the X-Y direction to cover your entire sample with 50 mm of focusing distance on the Z direction.

Light Engine
Our custom engineered DLP system features dual-LED illumination with wavelengths spanning **365 , 405, 460, and 532 nm.** High uniformity and power intensities: W_{365} > 200mW/cm^2, W_{405} > 400 mW/cm^2.

Projection Area
Pattern mm^2 to cm^2 areas with our modular optics platform. Standard 5x objective provides a 5 mm x 4 mm single projection (2x to 50x lenses are also available).

SOFTWARE

USER INTERFACE

The TERA eOS software package is intelligently designed and easy-to-use, making it an enjoyable and seamless operation of the E series.

PARAMETER CONTROLS

Control and monitor a variety of patterning parameters critical to your application, including light intensity and exposure time, applied contact force to work pattern on soft and hard surfaces, and complete control over design specifications for truly arbitrary surface patterning.

Nanofabrication Simplified.

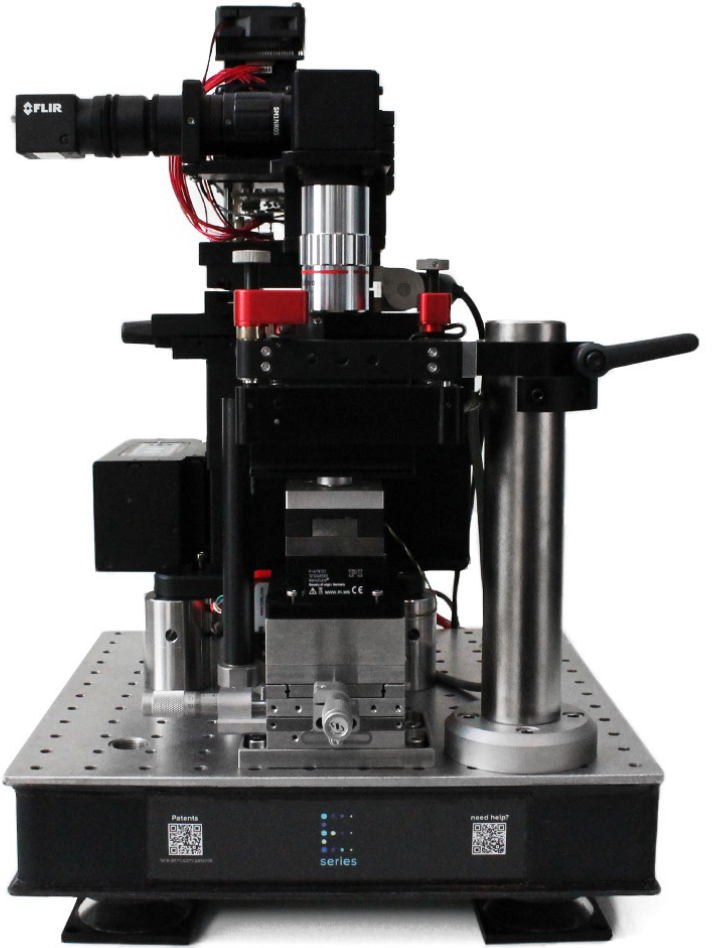
Rapid Prototyping

Broad Material Compatibility

Digital Photomask

Auto-Alignment

All at your desktop.



Recognition

Awards

2021 Chicago Innovation Award · Best Technology

This award recognizes the top innovators in the Chicagoland area with over 500 applicants that span a broad range of industries from non-profit organizations to deep tech. TERA-print's E series instrument was selected as the winner for the Best New Technology.

2020 SPIE Photonics West Prism Award · Life Sciences Category

This is an international contest between businesses of any size that develop advanced photonic-based technologies. The TERA-Fab E series was selected as the winner in the Life Sciences category for its ability to pattern tunable bio-based hydrogel materials with nanoscale precision.

Featured Publications

Photopolymerized Features via Beam Pen Lithography as a Novel Tool for the Generation of Large Area Protein Micropatterns

Zhang X, Ding S, Magoline J, Ivankin A, Mirkin CA. Photopolymerized Features via Beam Pen Lithography as a Novel Tool for the Generation of Large Area Protein Micropatterns. Small. 2022. doi: 10.1002/smll.202105998.

Orthogonal Images Concealed Within a Responsive 6-Dimensional Hypersurface

Zholdassov, Yerzhan & Valles, Daniel & Uddin, Samiha & Korpanty, Joanna & Gianneschi, Nathan & Braunschweig, Adam. (2021). Orthogonal Images Concealed Within a Responsive 6-Dimensional Hypersurface. Advanced Materials. 33. 10.1002/adma.202100803.

Foundational Publications

Desktop nanofabrication with massively multiplexed beam pen lithography

Liao, X., Brown, K., Schmucker, A. et al. Desktop nanofabrication with massively multiplexed beam pen lithography. Nat Commun 4, 2103 (2013). https://doi.org/10.1038/ncomms3103

Beam Pen Lithography

Huo, F., Zheng, G., Liao, X. et al. Beam pen lithography. Nature Nanotech 5, 637–640 (2010). https://doi.org/10.1038/nnano.2010.161

Additional Reading

CONTACT

Jared Magoline
Director, Sales & BD
jaredmagoline@teraprint.us
(920) 238-7223

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