

XFab Micromachining : Uses & Limitations

Abdul Obaid, Mina Hanna
Mentor: Michelle Rincon
ENGR 241, Fall 2017



Stanford
ENGINEERING

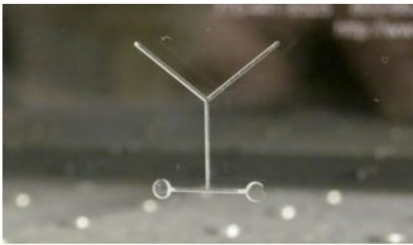
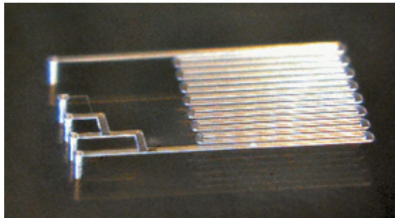
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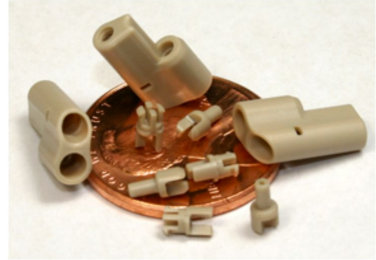
Presentation Outline

- Tool Introduction - MiniTech Micromill
- Motivation
 - Microfluidics
 - Shadow Mask
- Tool Best Practices
 - Fixturing, Coolant, Tool Fidelity & Speed, GCode
 - Modifications Made to Tool
 - Updated Run Sheet
- Microfluidic & Shadow Mask Progress
 - Materials Use, Recommended Parameters & Tool Limitations
- Executive Summary, Future Recommendations

MiniTech Micromill



Direct Microfluidic Patterning

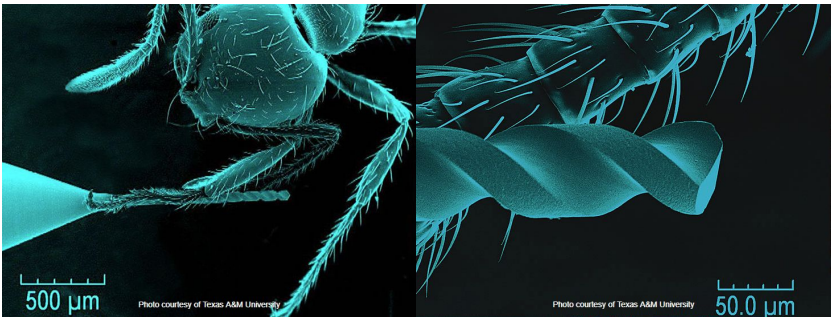
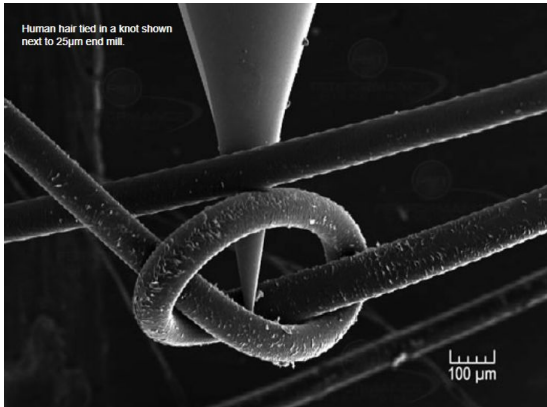


MicroMachining for Medical Device Parts

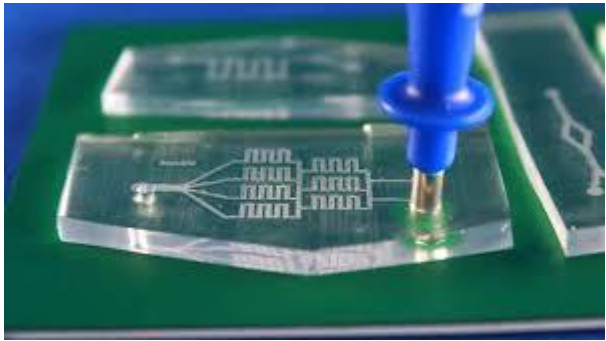
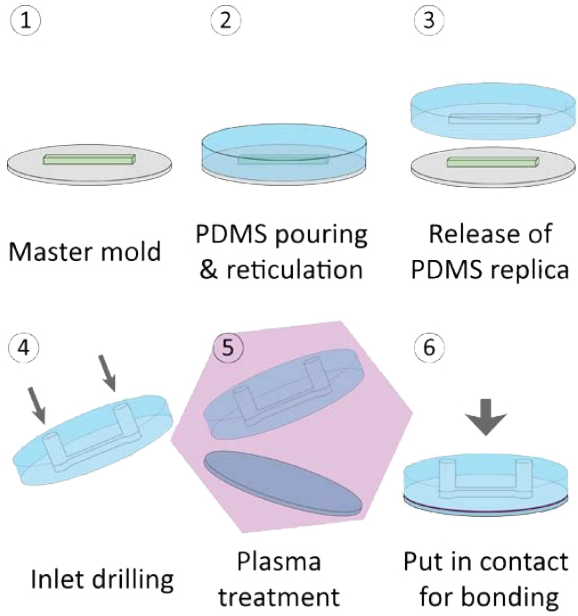
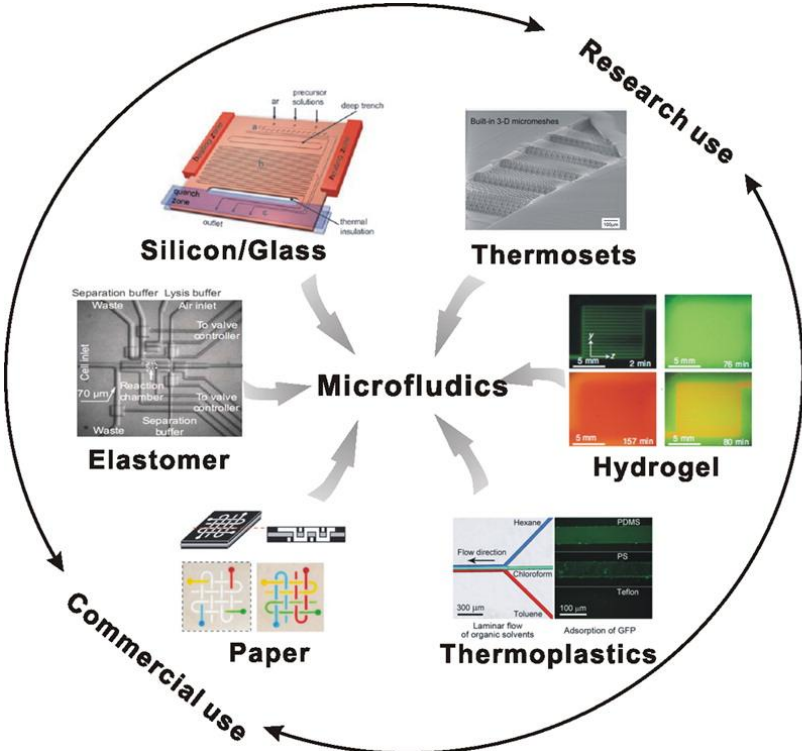


MiniTech Micromill

End Mills down to
5 μm in diameter
(0.0002 in)

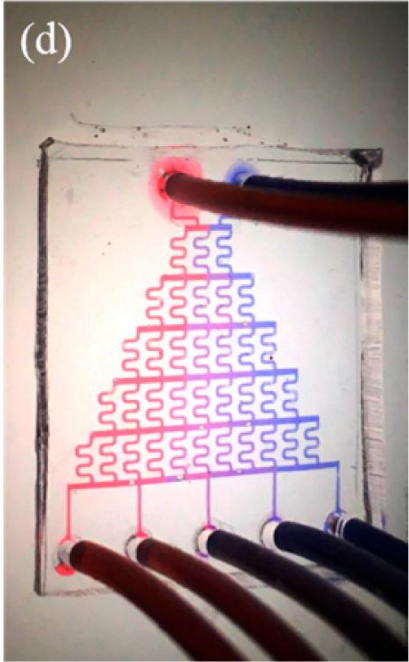
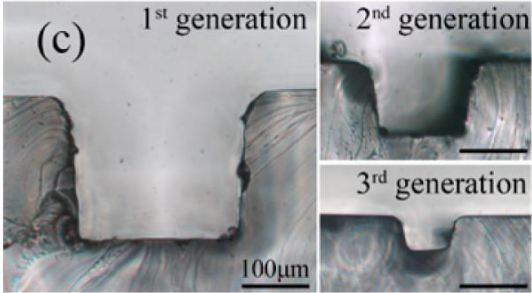
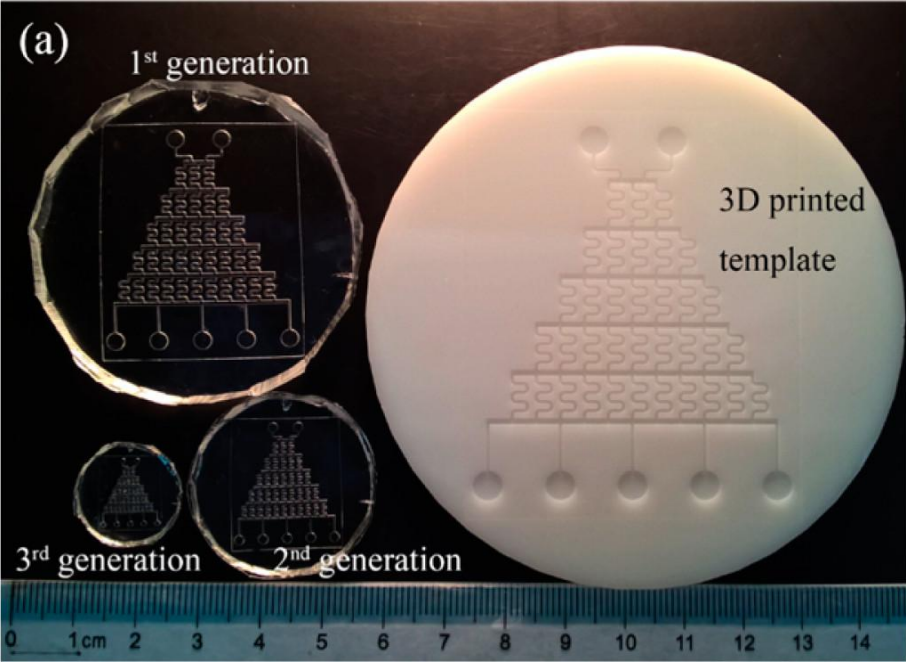


Microfluidic Patterning



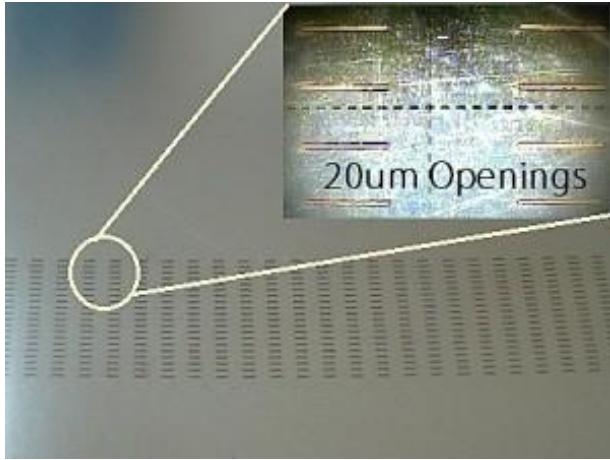
Microfluidic Patterning

Employment of Specialized 3D printed techniques

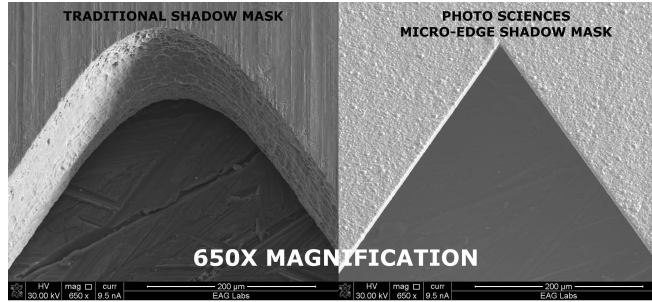
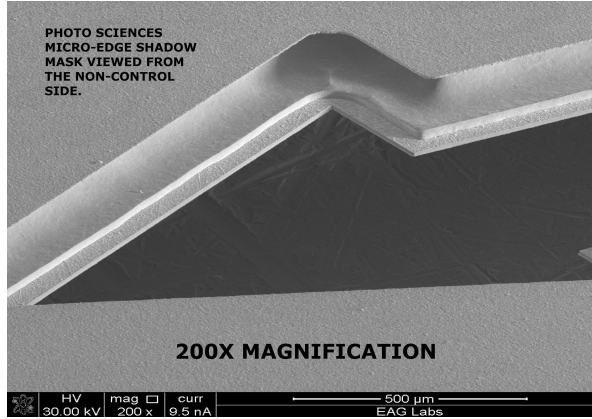


Shadow Mask Production

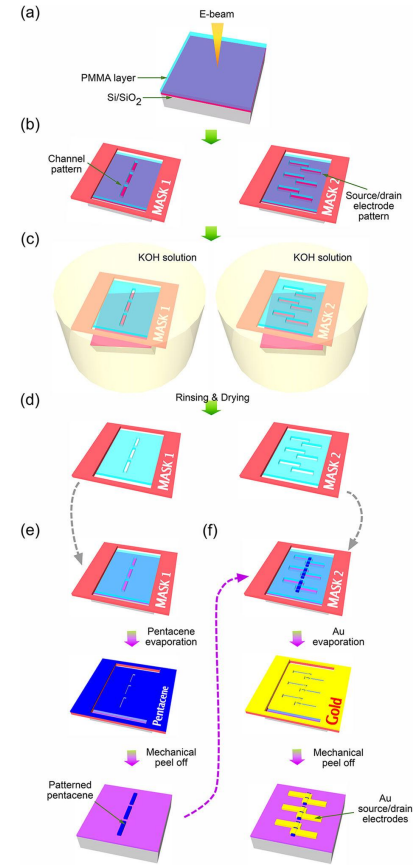
Current Methods Employed in Shadow Mask Production - 10's microns resolution



Laser Cutting, 20 um



PhotoChemical Machining - typically 20 um, down to 2.5 um resolution



E-Beam Defined

End Mill Operation, Executive Summary

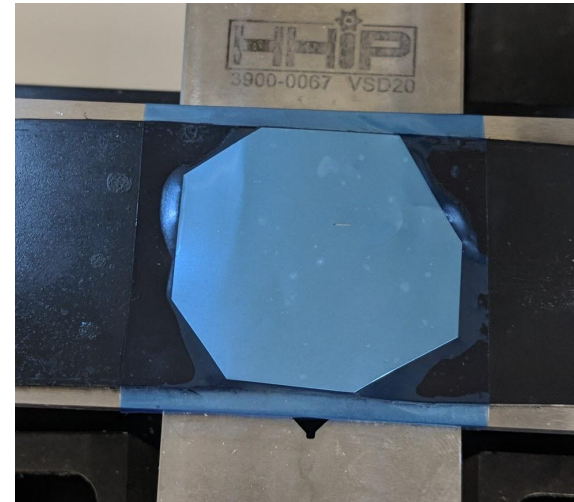
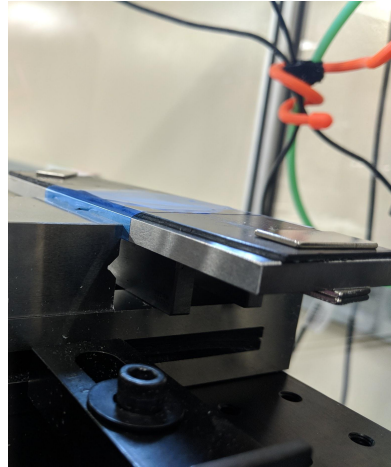
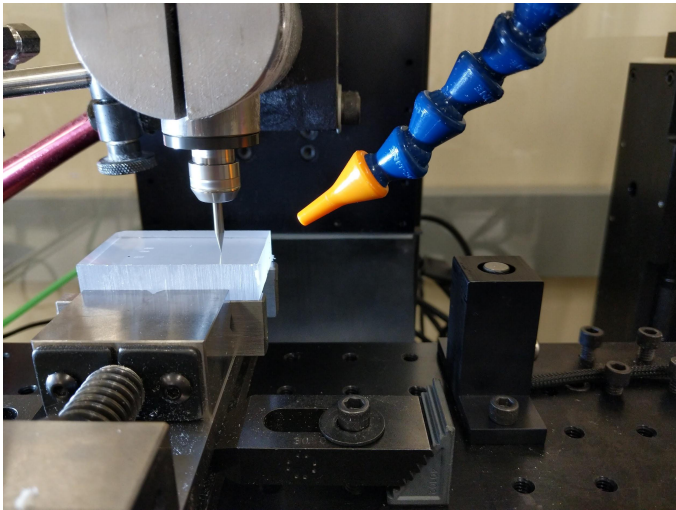
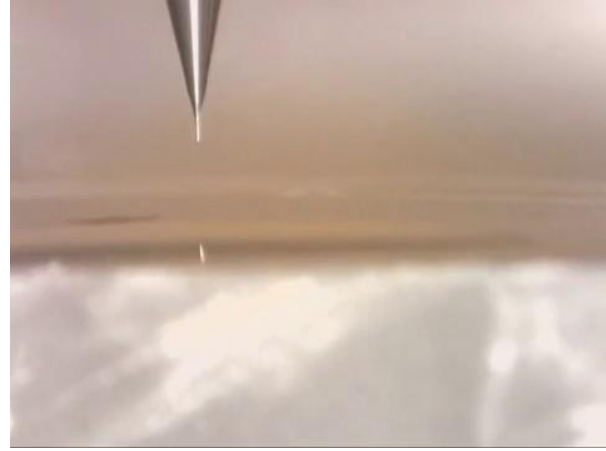
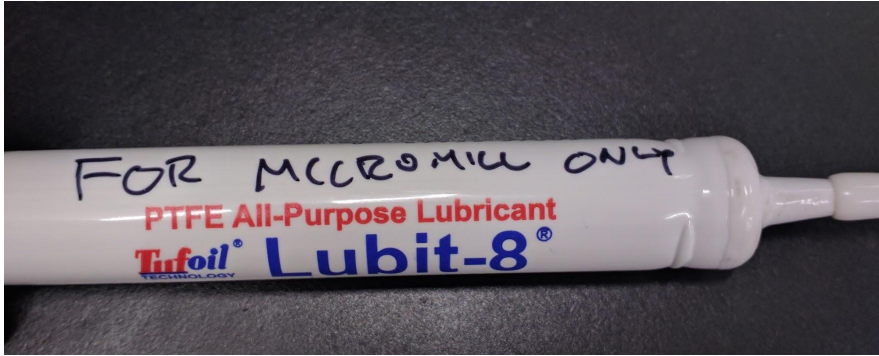
Recommended Tool Speeds (0.5% of Diameter = Feed Rate):

End Mill Diameter

	2 mm	400 um	100 um	50 um	20 um	
Material	Al (65 um)	1000 RPM	5150 RPM	20600 RPM	41250 RPM	103100 RPM
	PC (N/A)	600 RPM	3000 RPM	11900 RPM	23800 RPM	59500 RPM**
	SS (60 um)	400 RPM	2000 RPM	8000 RPM	15900 RPM	39700 RPM

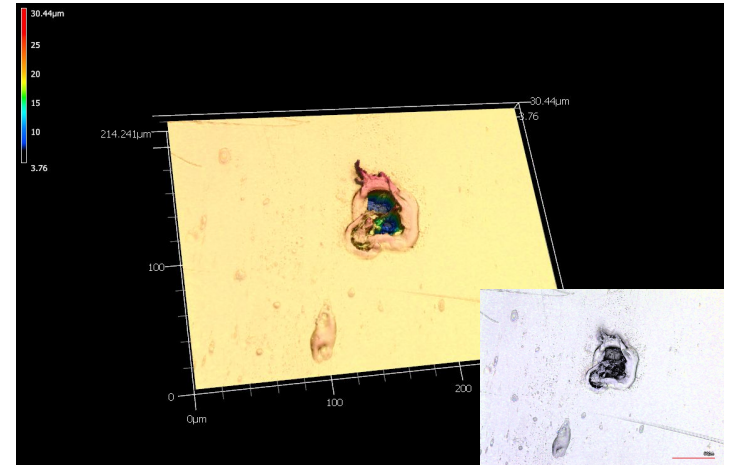
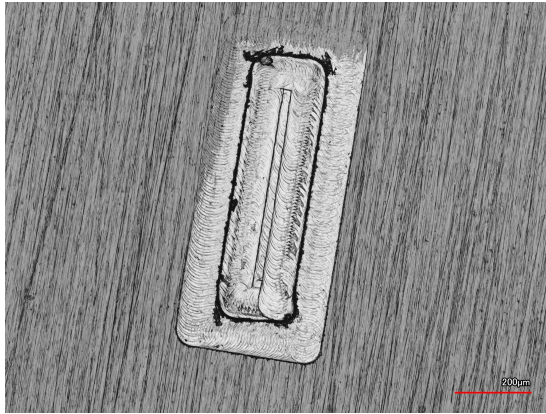
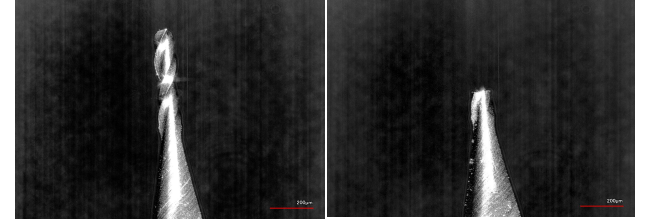


Coolant & Fixturing



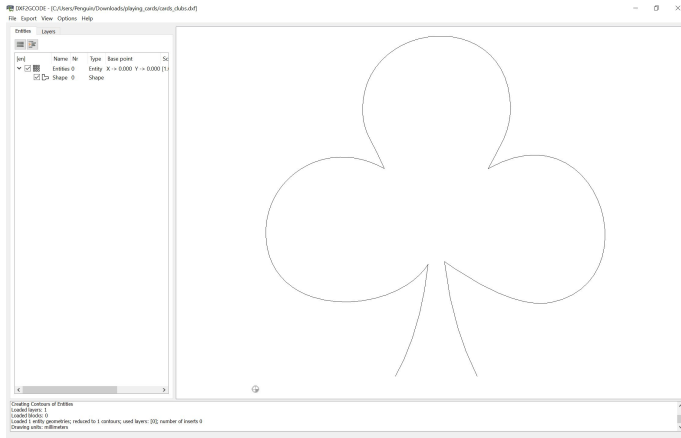
End Mill Operation, Recommended Settings

- Verify tips before using, they break very easily and can damage the tool
- Below 50 μm Diameter bit, observation through microscope necessary, otherwise attached camera can't resolve. For tough materials, microscope inspection of end mill quality highly recommended



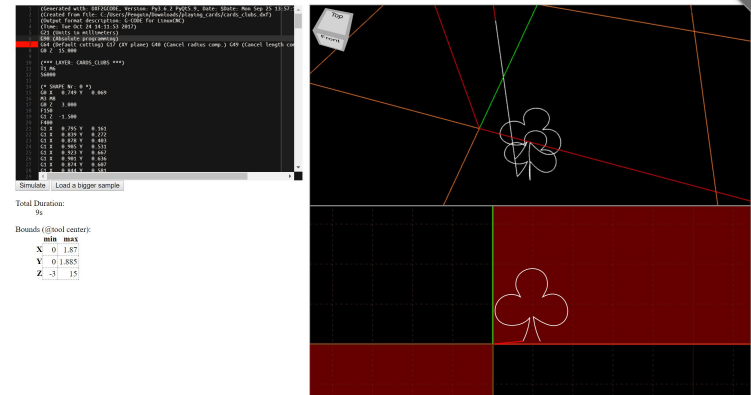
G-Code

- Use open source software (DXF2GCode) to create arbitrary patterns
- Use G-Code simulator to verify proper translation of units and edges
- Great for larger patterns
 - Can't control tool speed, making fine patterns (<50 um) more 'jagged'

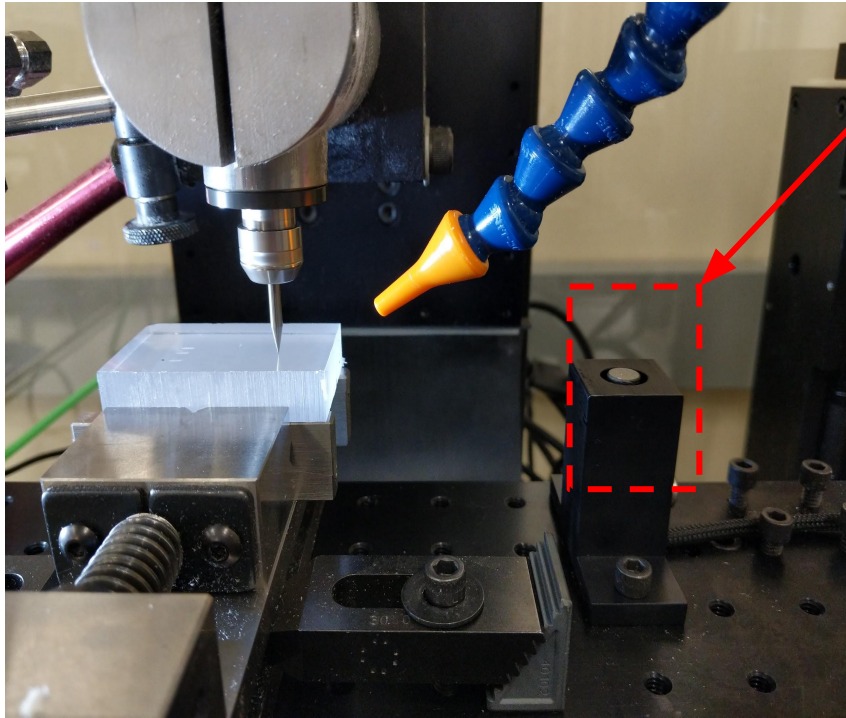


G-Code Q'n'dirty toolpath simulator

Paste your g-code in the left-hand window and see the preview of your tool path on the right. The right-hand pane are interactive, drag them to change the point of view.

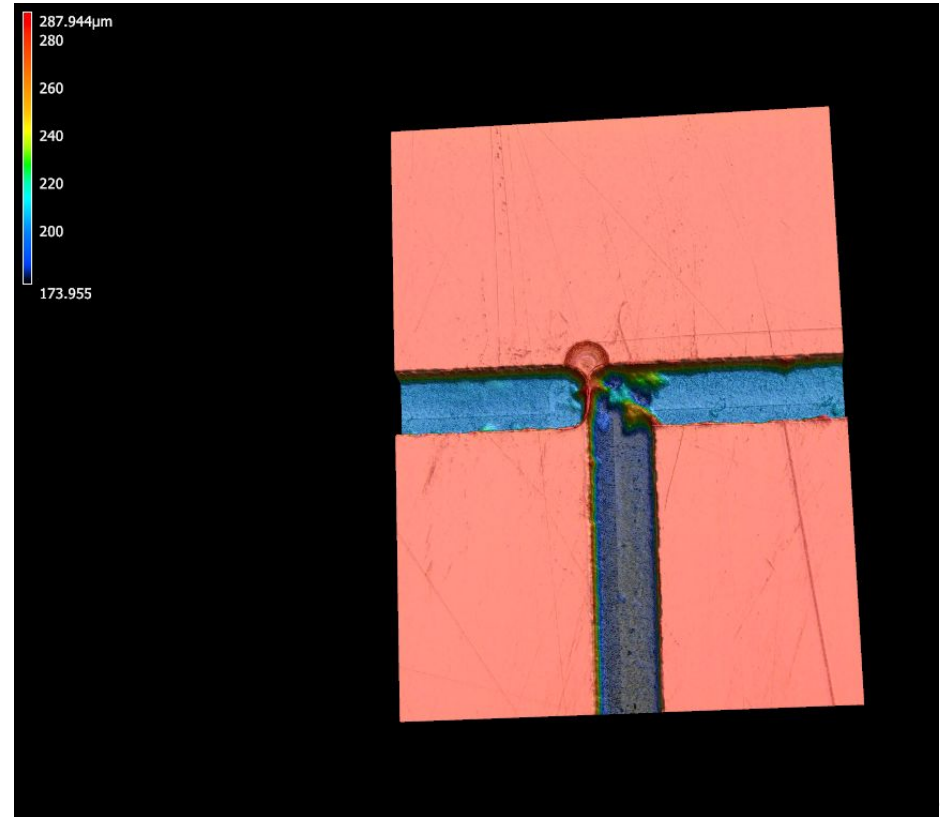
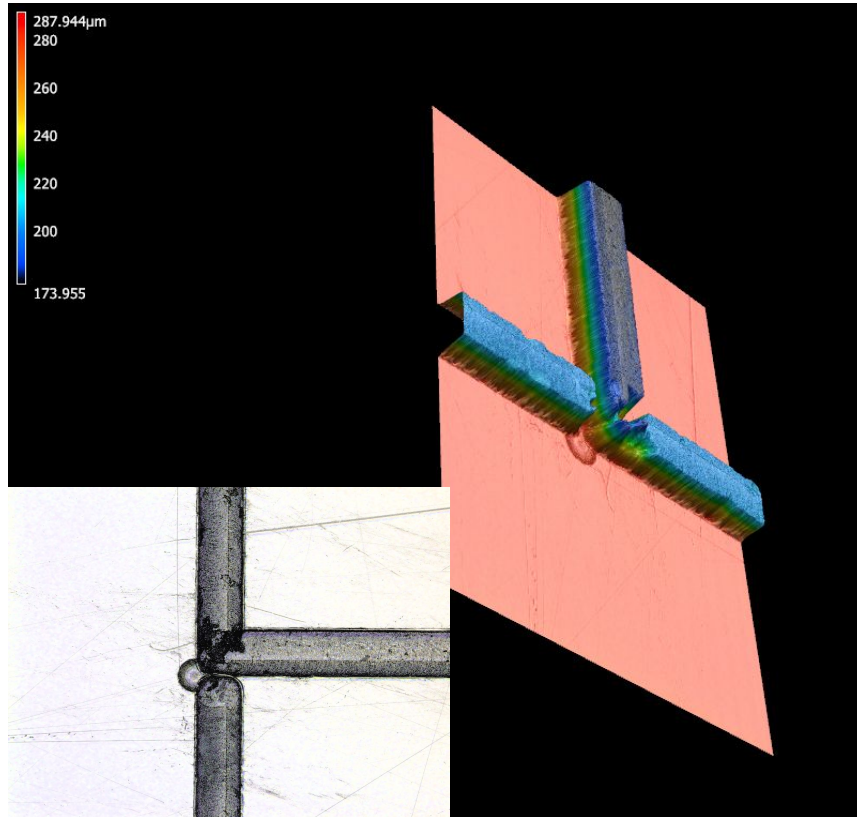


Tool Shutdowns & Bypasses

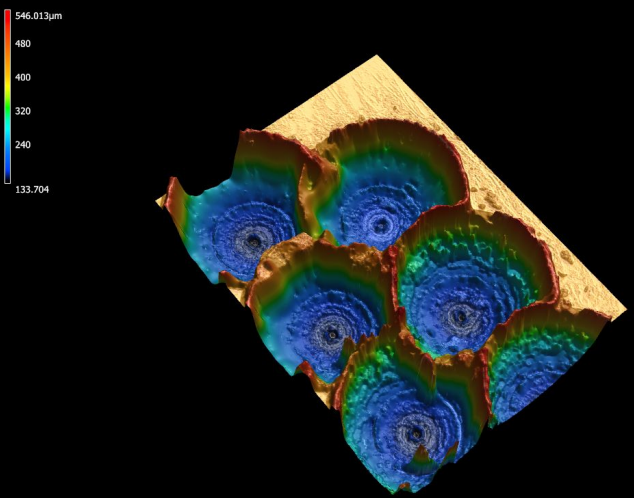
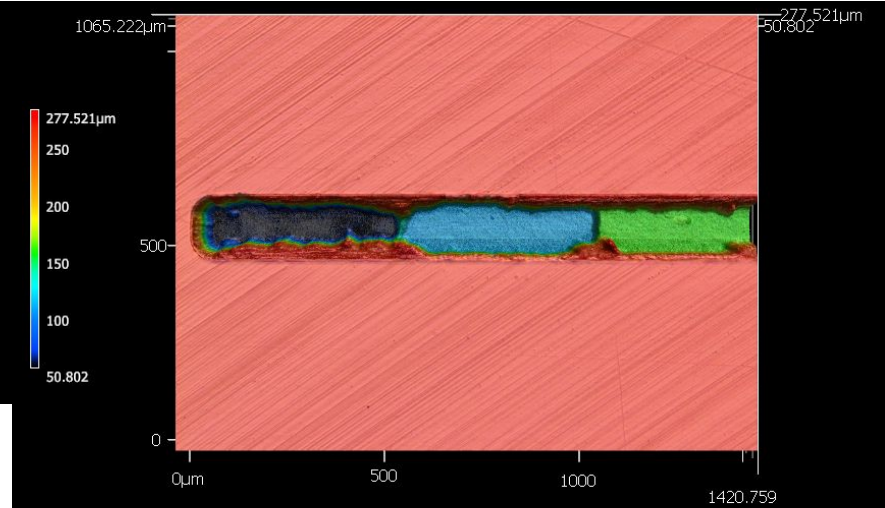
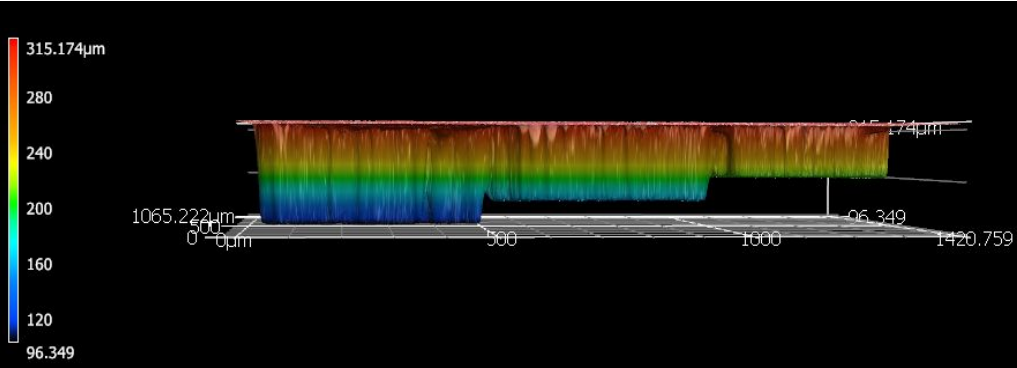


- Established bypass protocol when calibration sensor is damaged
- Calibration sensor is prone to being damaged, especially if using damaged end mills
- Bypass protocol not recommended for end mills less than 100 μm in diameter, as the drill bit is much more prone to damage and breaking.
- Dulling of 400 μm end mills evident when sensor isn't operational.

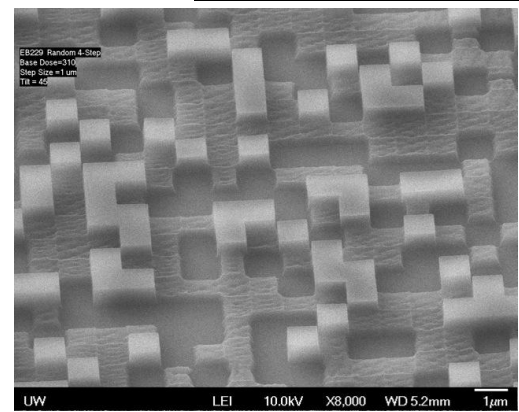
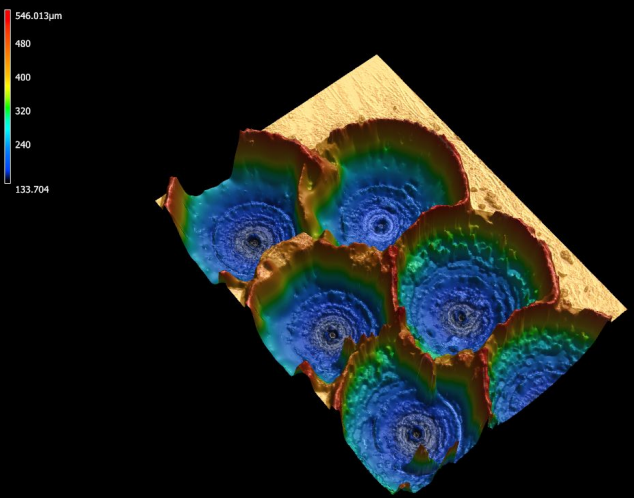
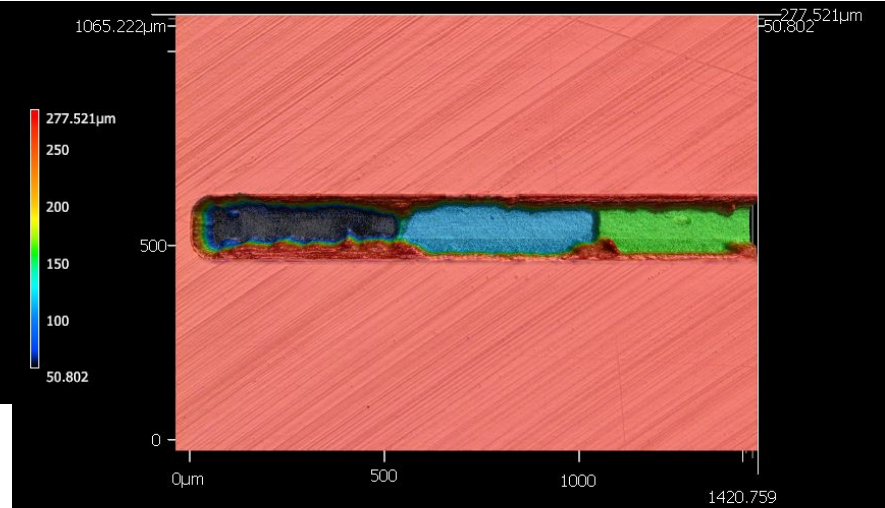
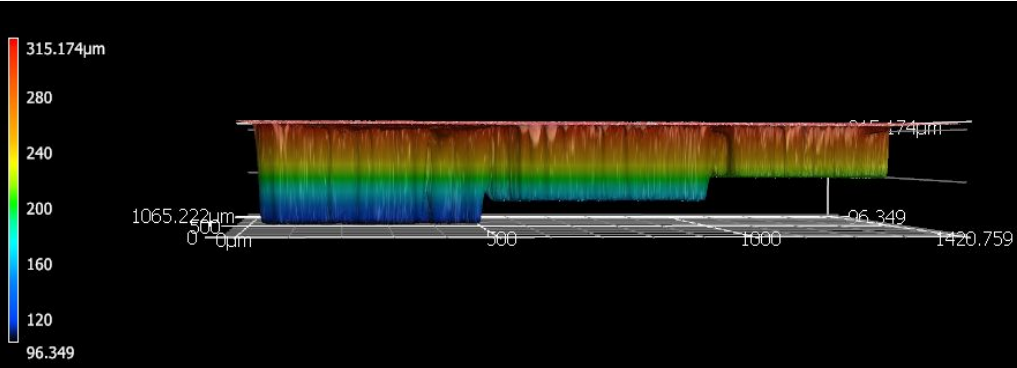
Microfluidic Patterning & Limitations



Microfluidic Patterning & Limitations



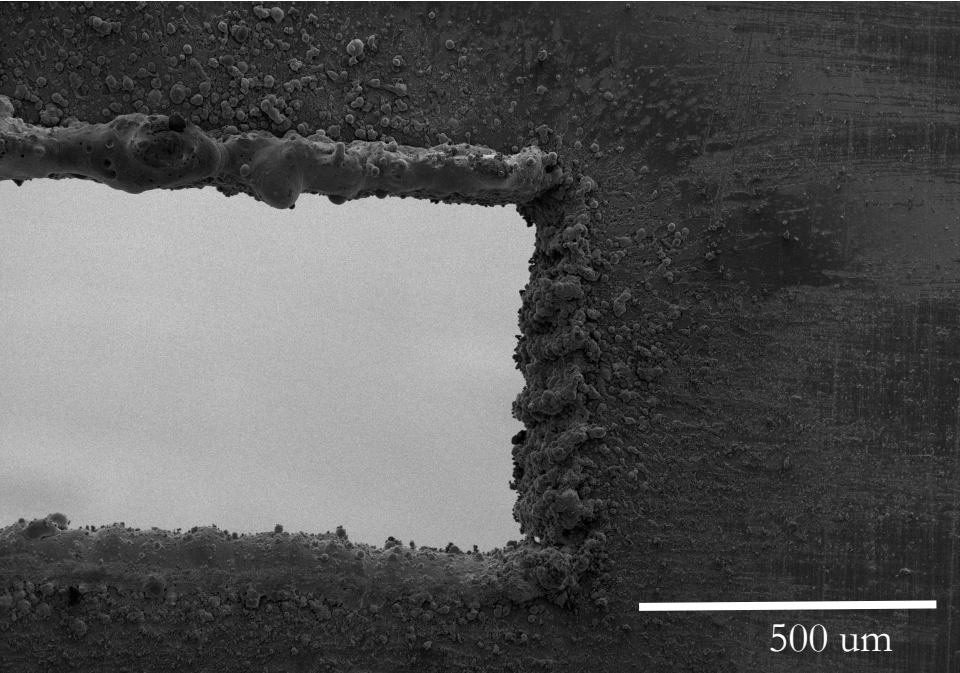
Microfluidic Patterning & Limitations



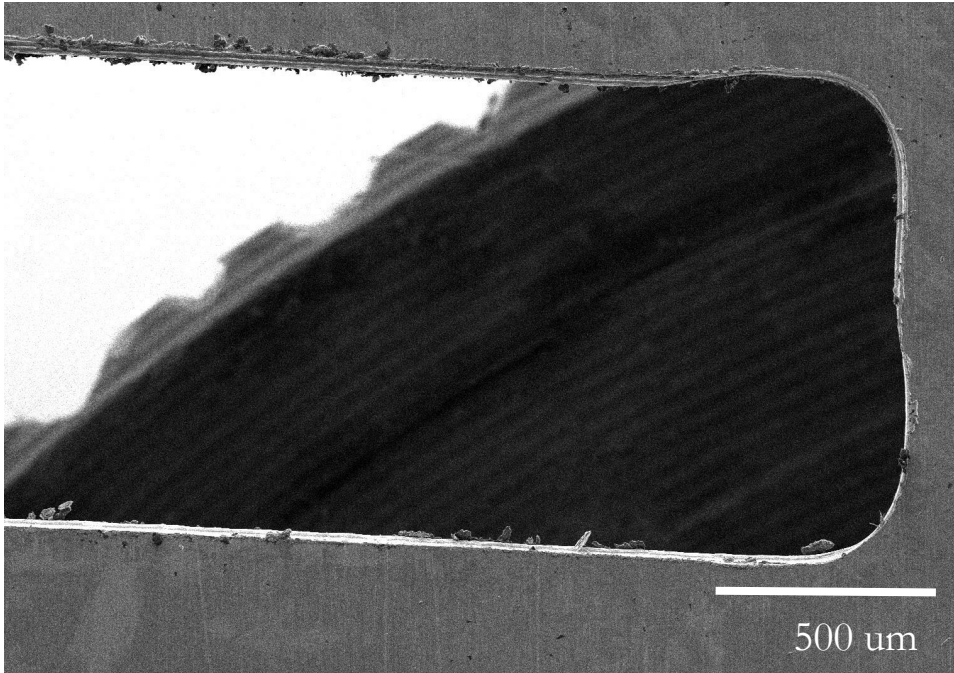
Additionally an alternative to grayscale lithography

Shadow Mask Production & Limitations

Laser Cutter

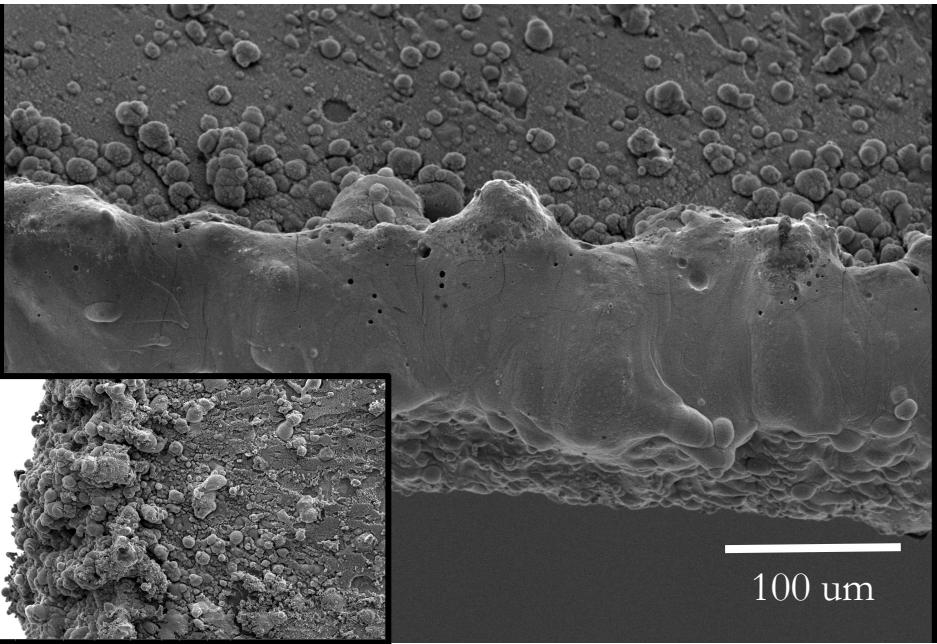


Micro Mill

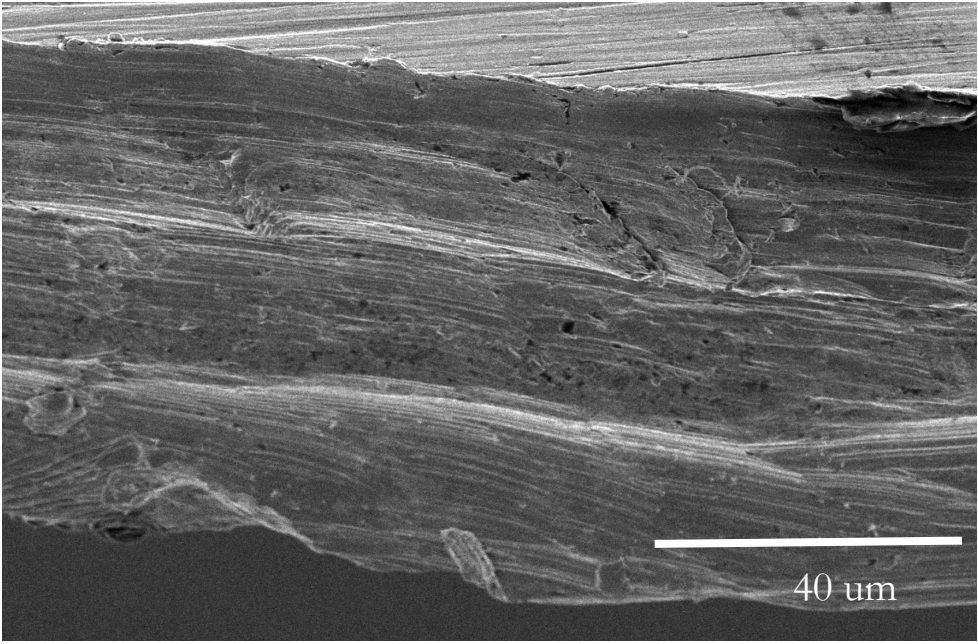


Shadow Mask Production & Limitations

Laser Cutter

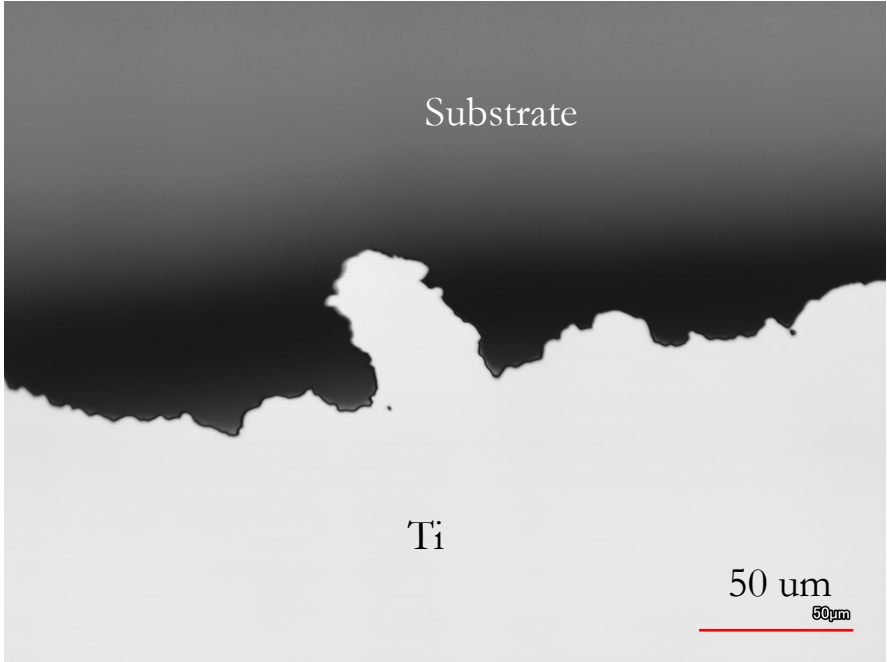


Micro Mill

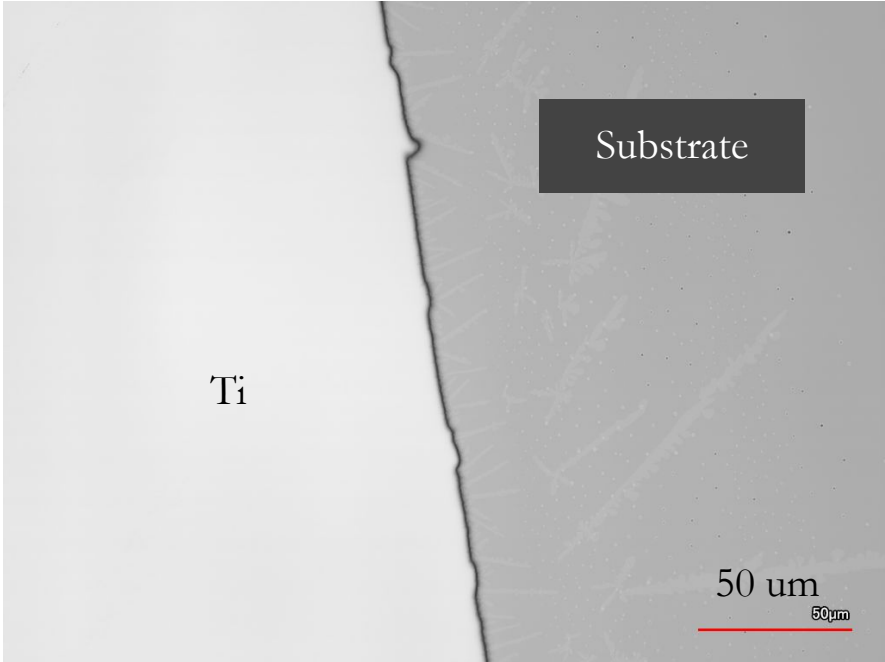


Shadow Mask Production & Limitations

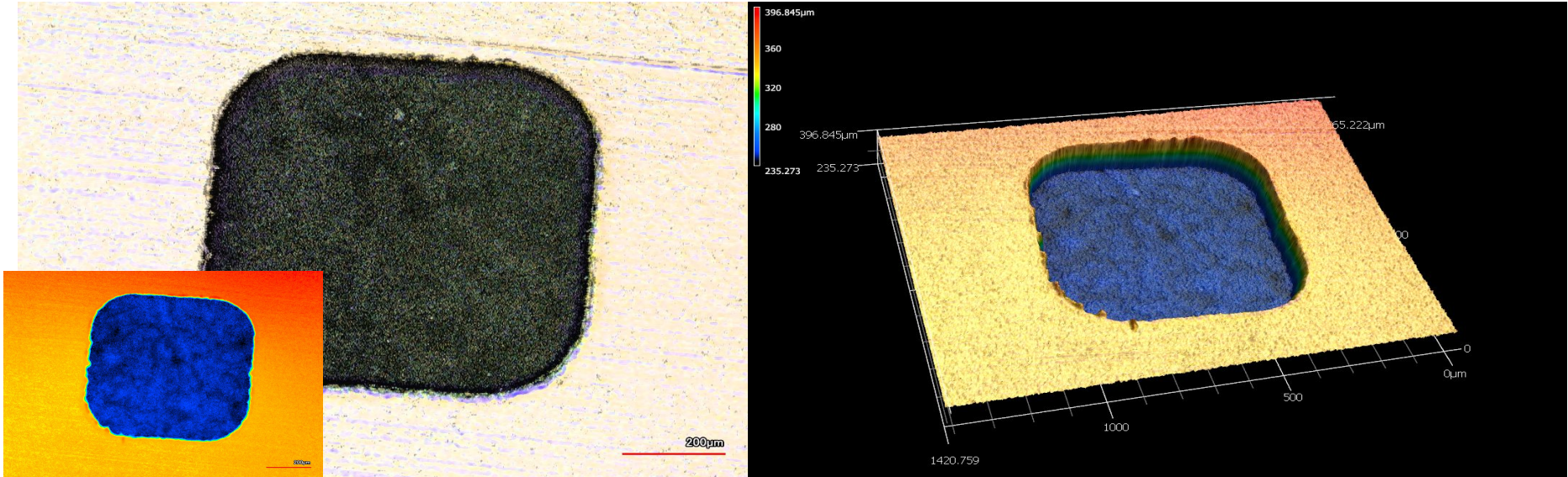
Laser Cutter



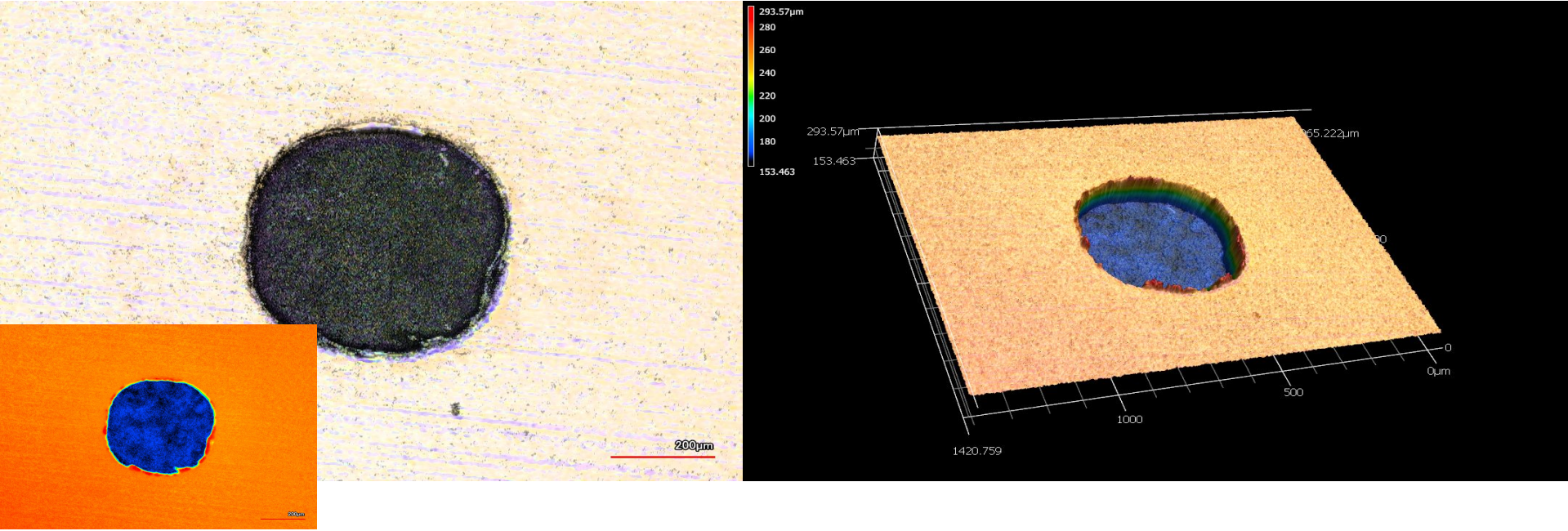
Micro Mill



Shadow Mask Production & Limitations



Shadow Mask Production & Limitations



Thank You!