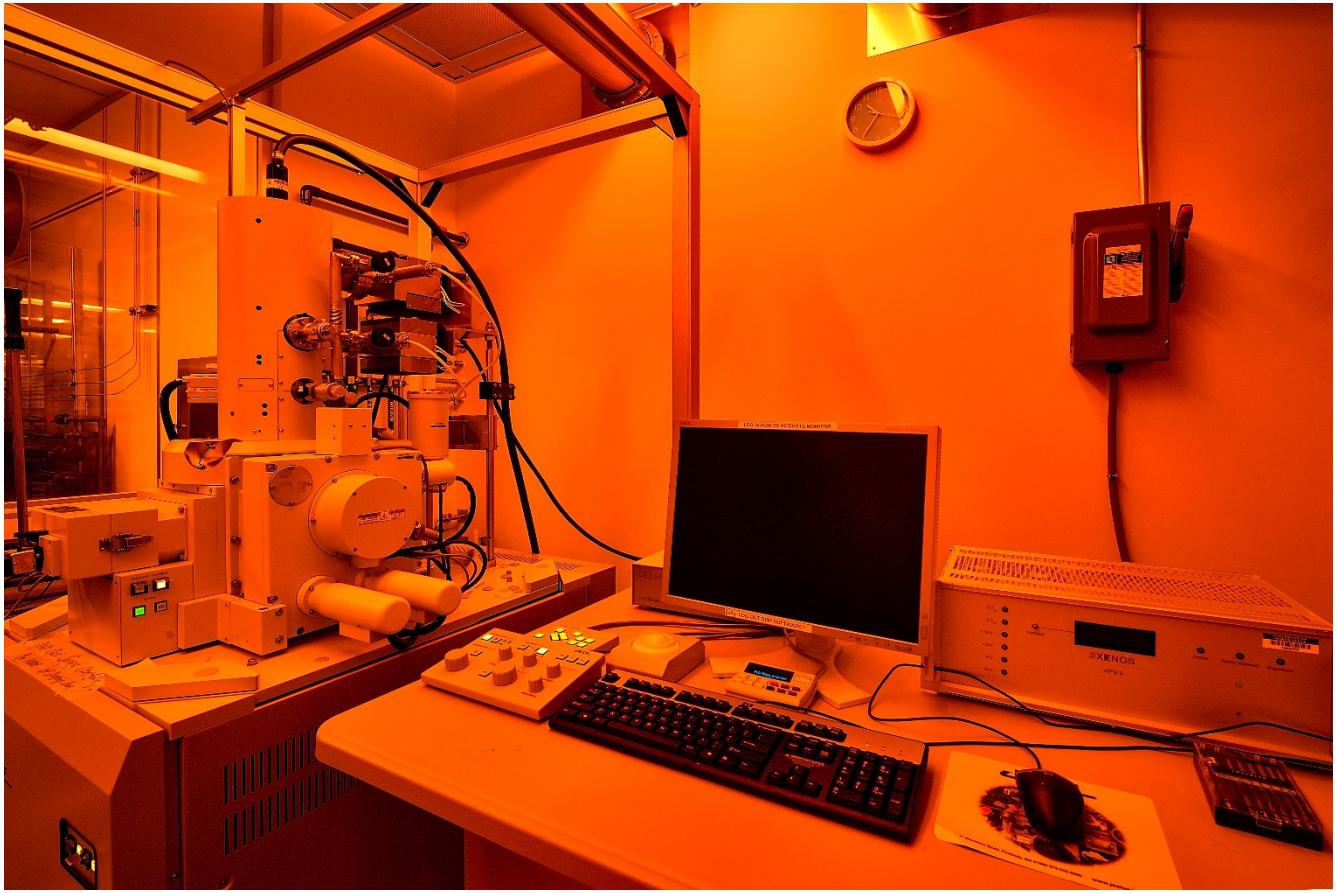
UNT MRF-Nanofabrication Cleanroom (NFCR)

Capacity update. Dec,2020

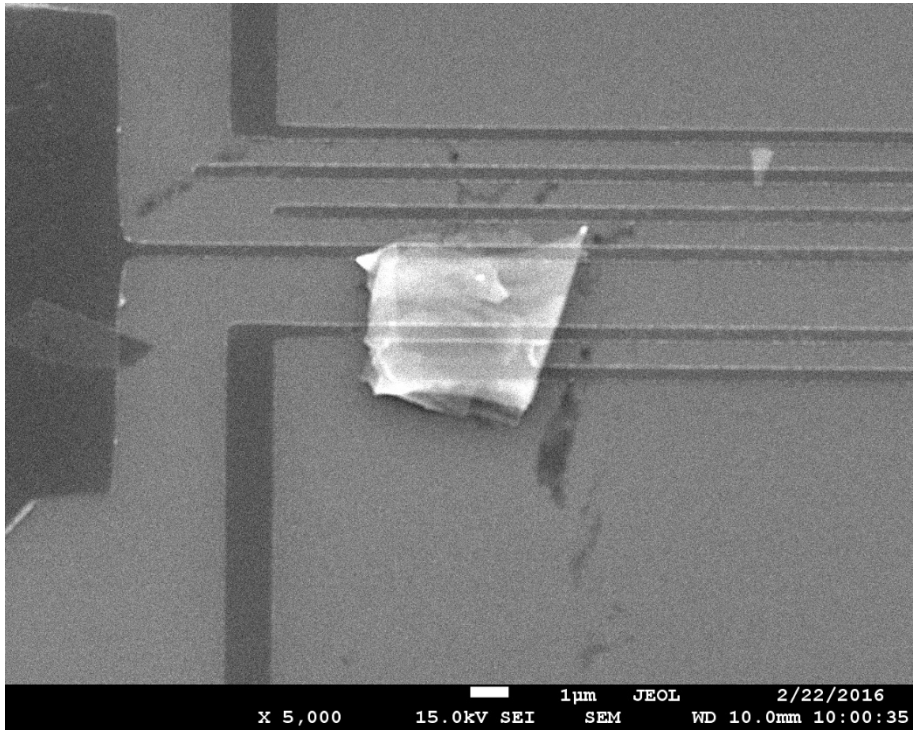
Cleanroom Capacity Update

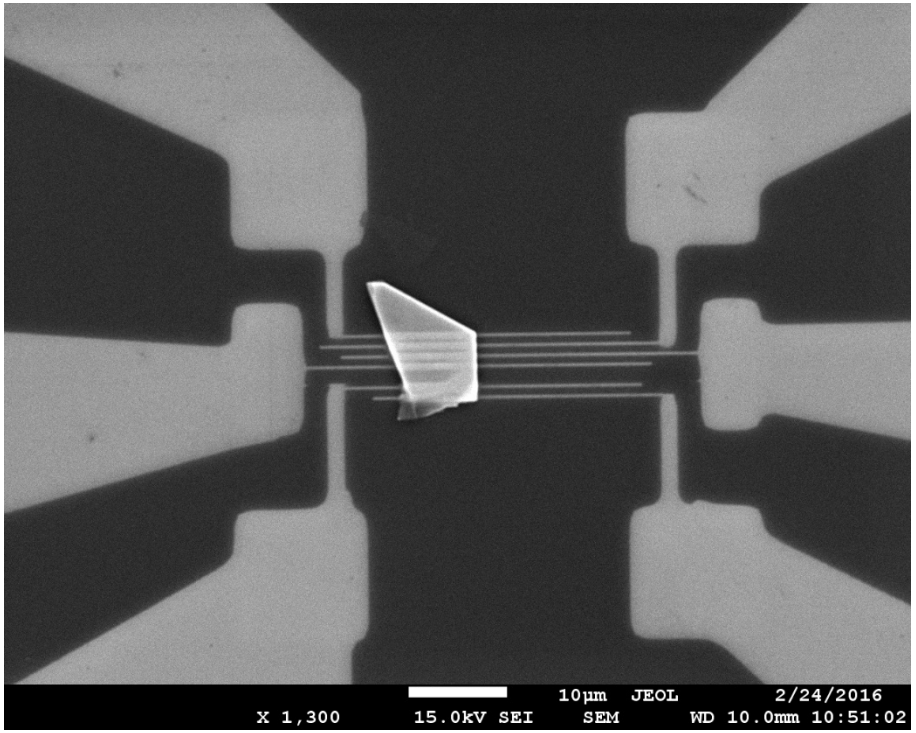
- Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator
- Maskless Photolithography: Heidelberg Laser writer
- Trovato OLED System
- RIE Etching Capacity
- User EBL Example
- External User Application

Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator



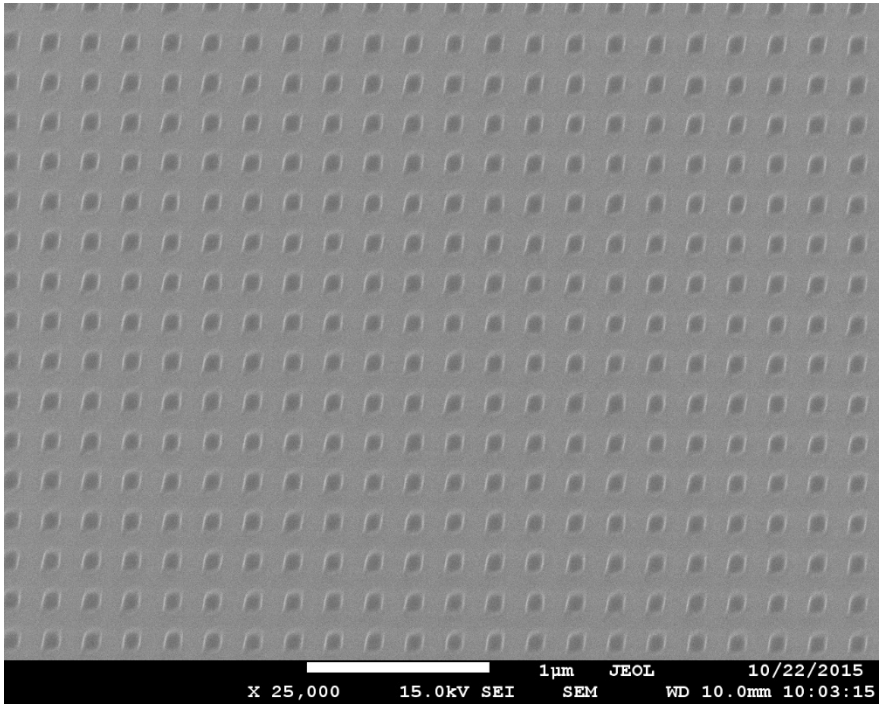
Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator

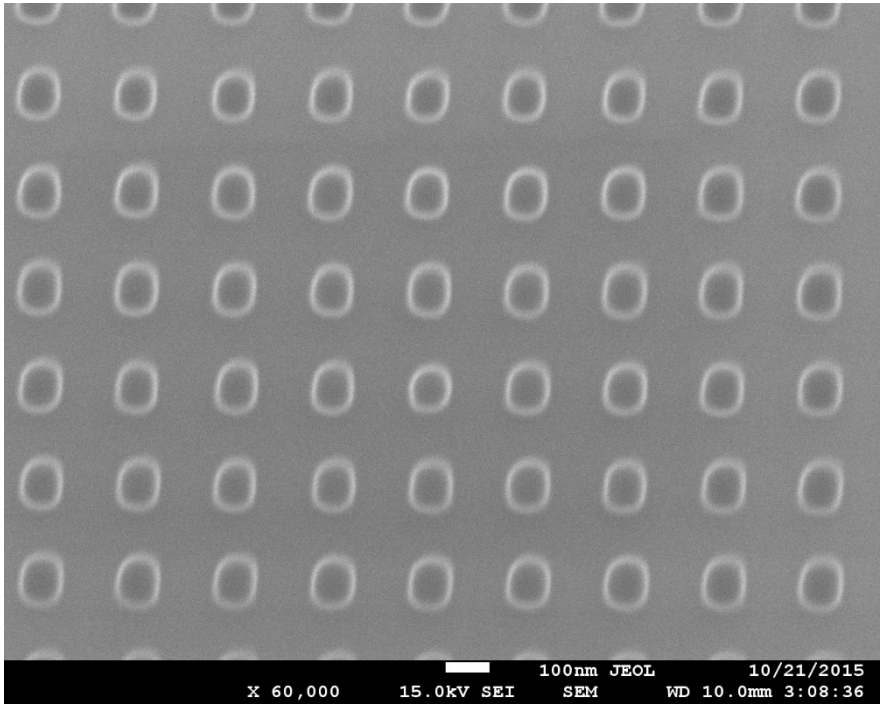




Contact patterns on <10 um MoTe2 flakes.
After liftoff (left) and after development (right)

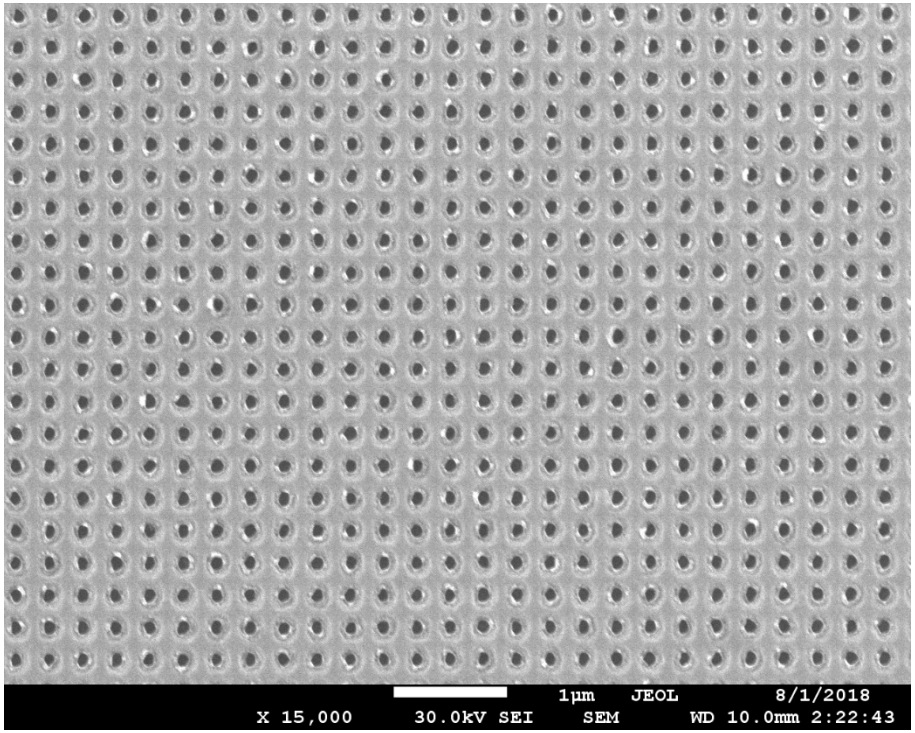
Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator

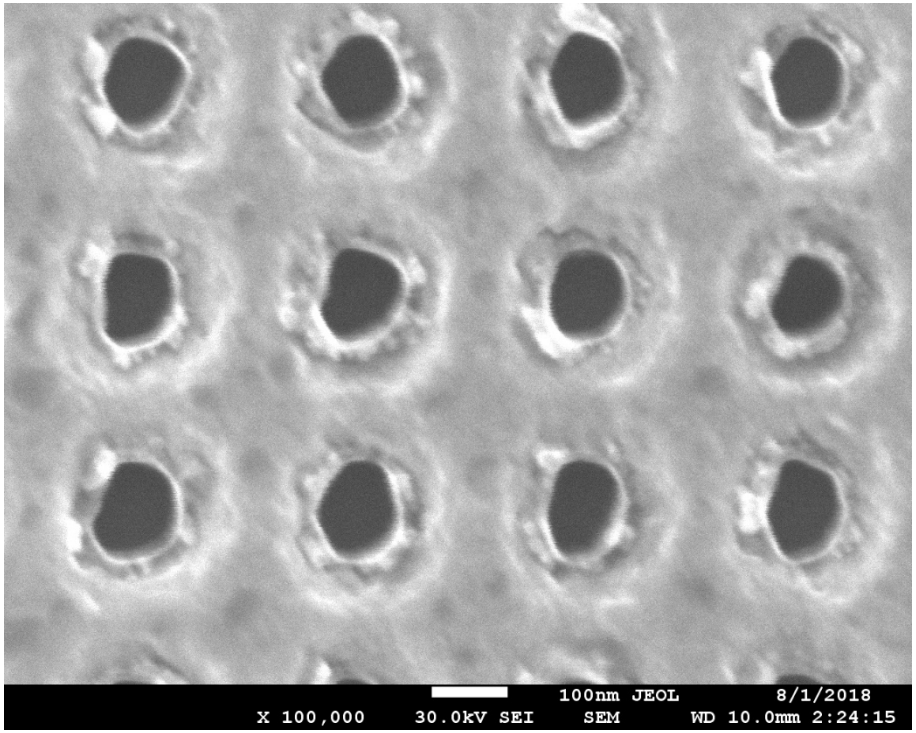




Fishnet pattern after development.
Field size 100 um and 120x120 nm grids

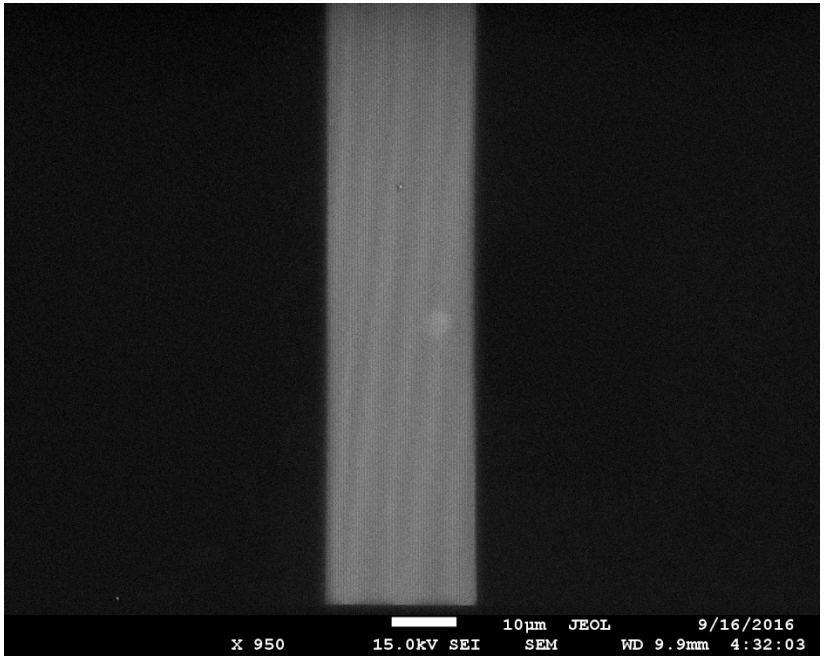
Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator

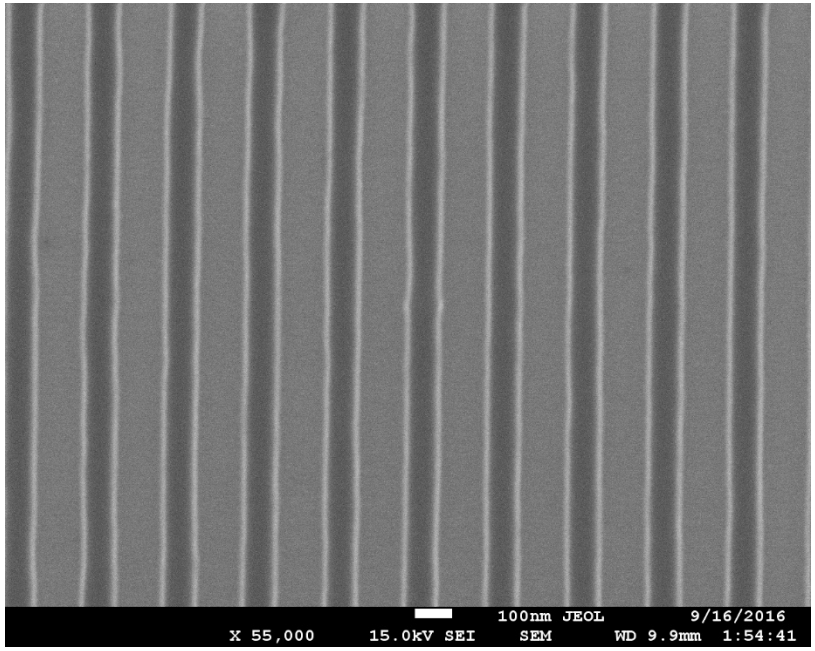




Fishnet pattern after deposition of Ag/Al2O3 multilayers and lift off.
Field size 100 um and 120x120 nm grids

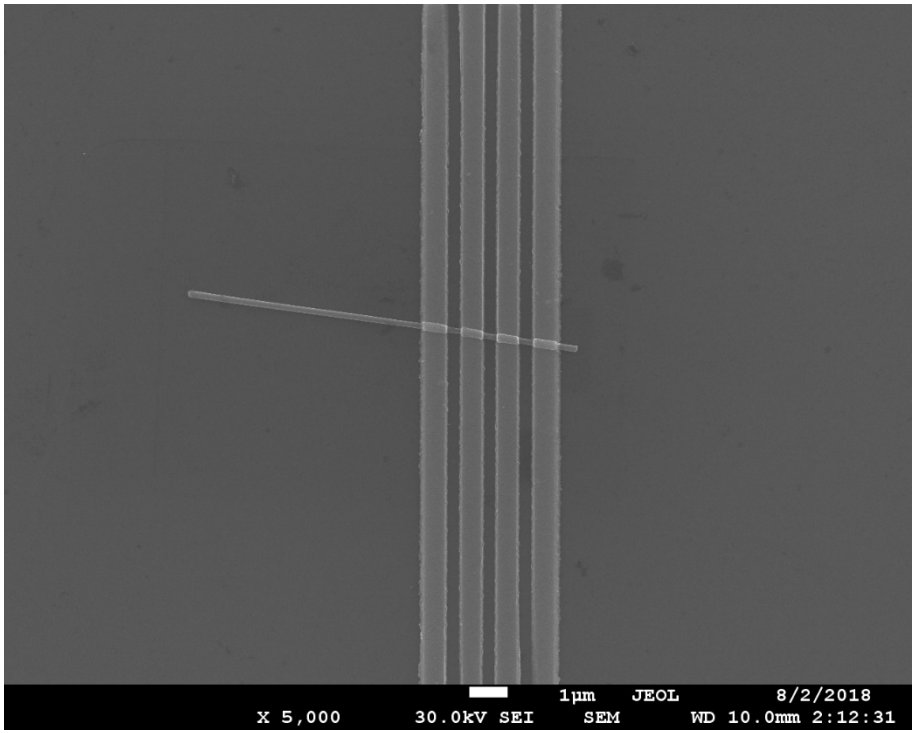
Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator

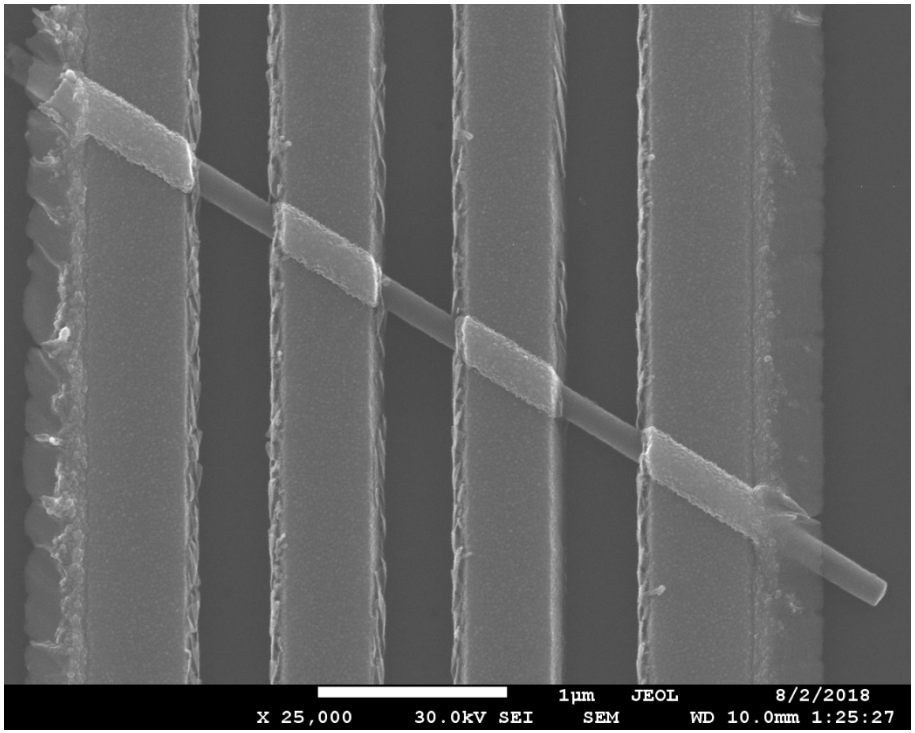




Line patterns for graphene etching.
Field size 100 um and 100 nm lines and 100 nm gaps.

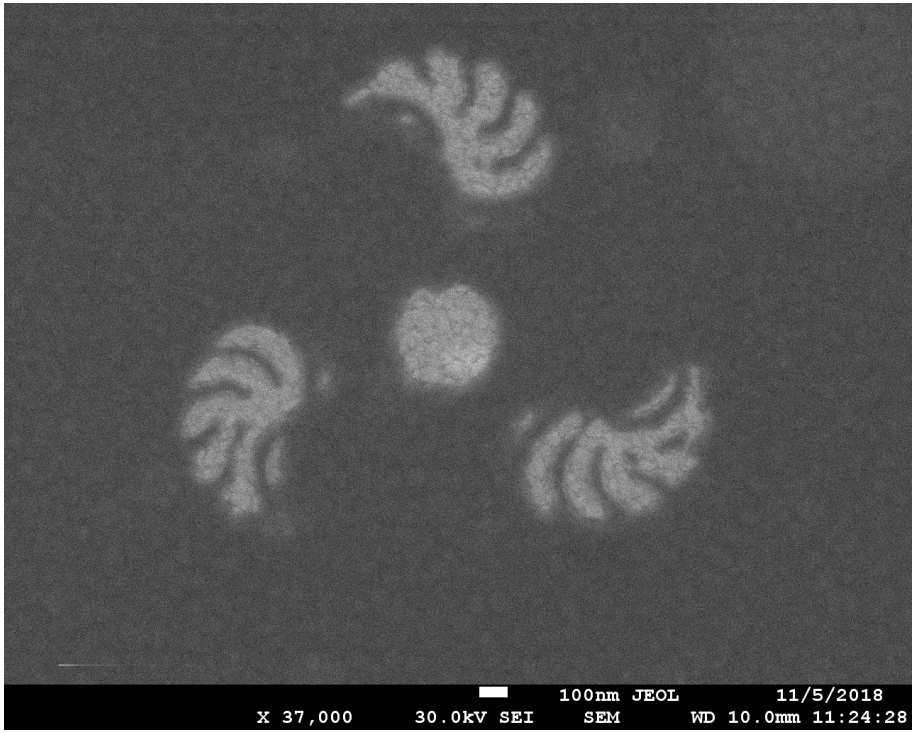
Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator

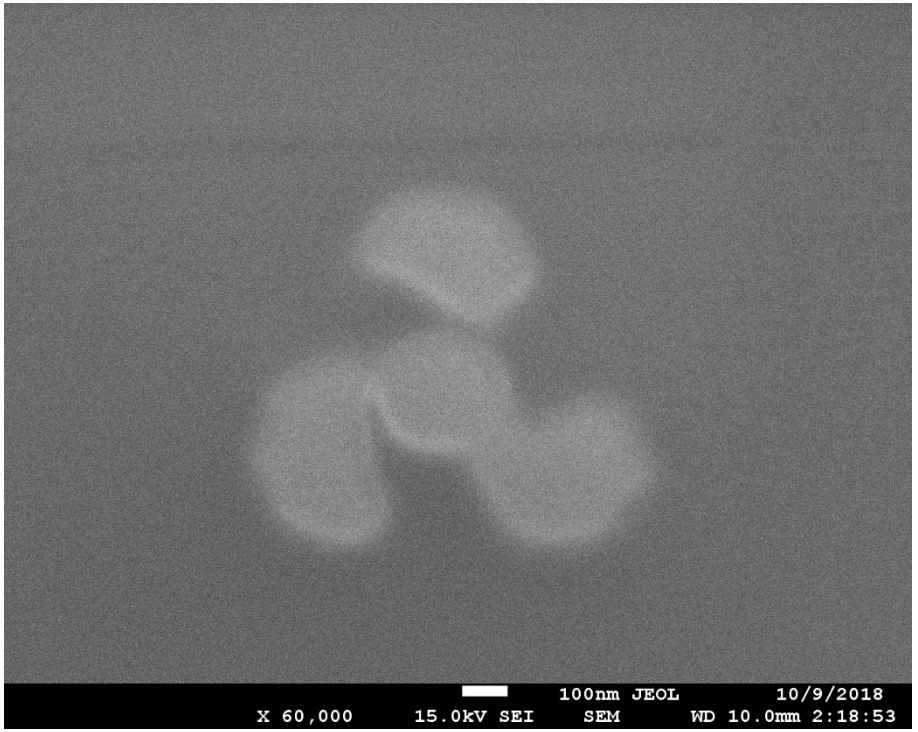




nanowire contact patterning.

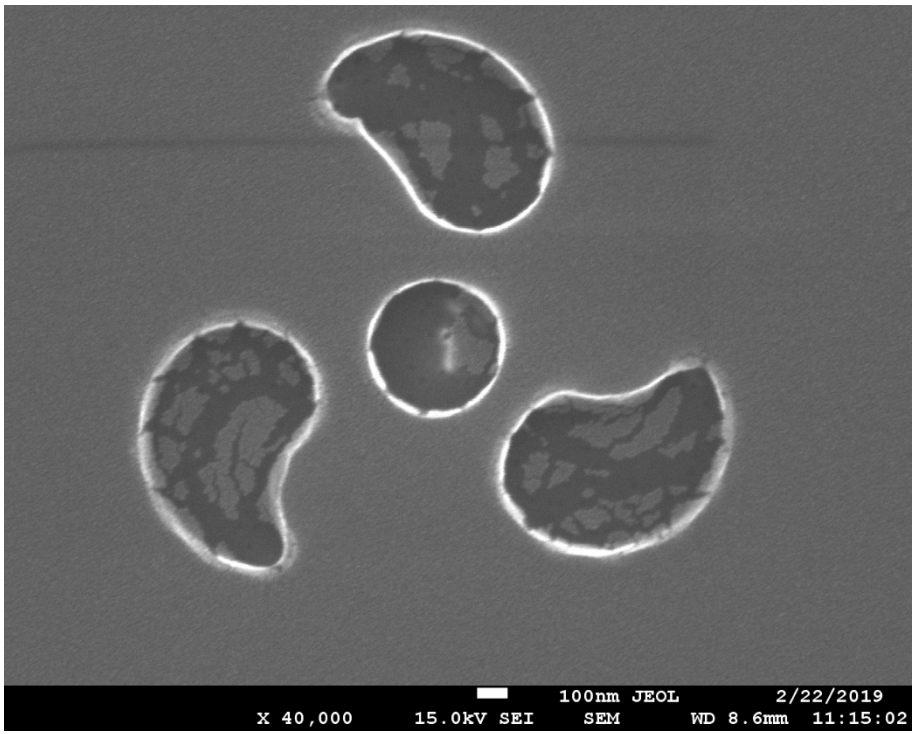
Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator

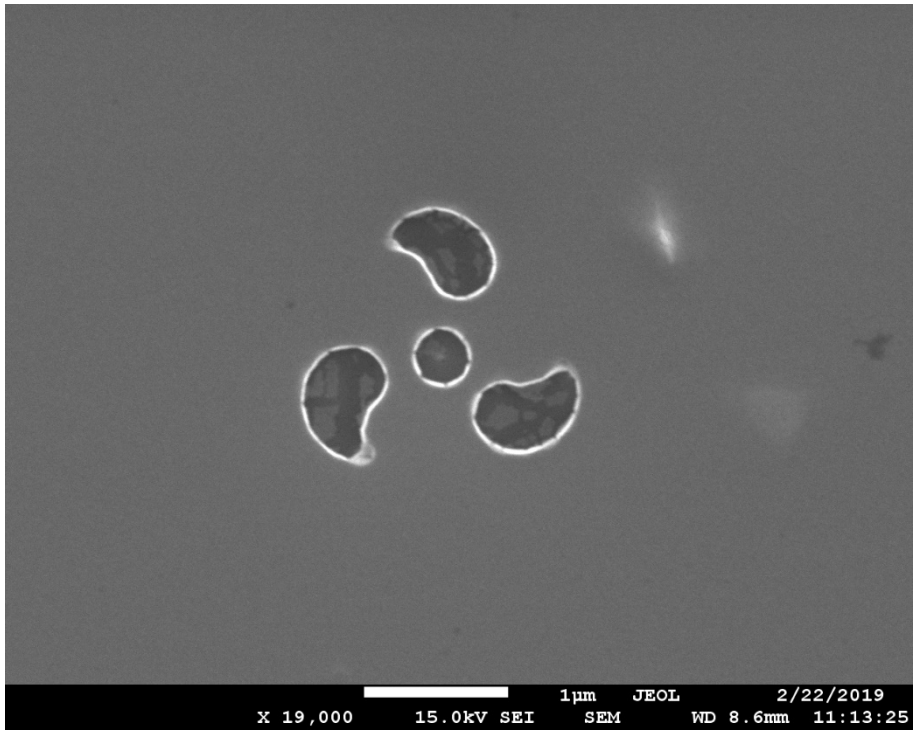




Yin-yang pattern

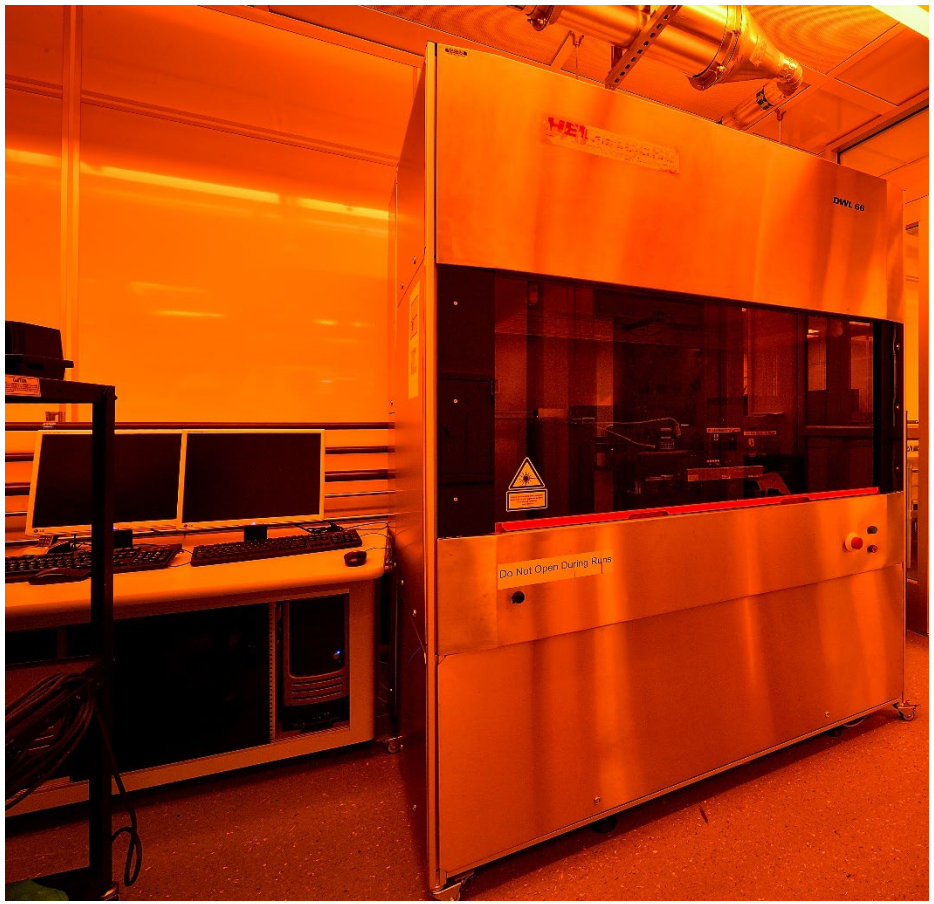
Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator





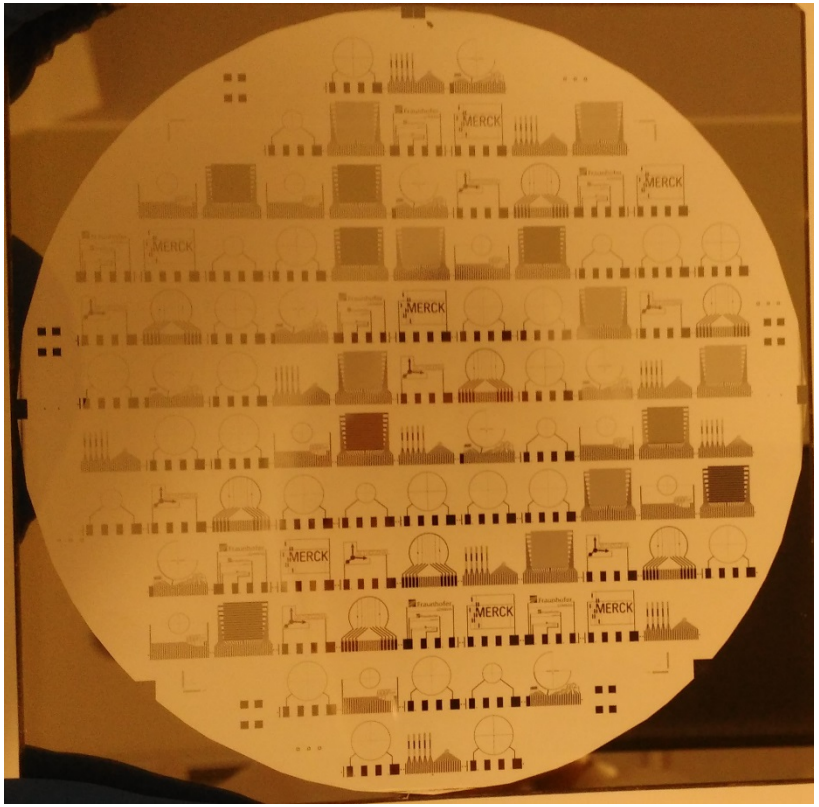
Yin-yang pattern on glass after development

Maskless photolithography: Heidelberg Laser Writer Chemical Processing Stations



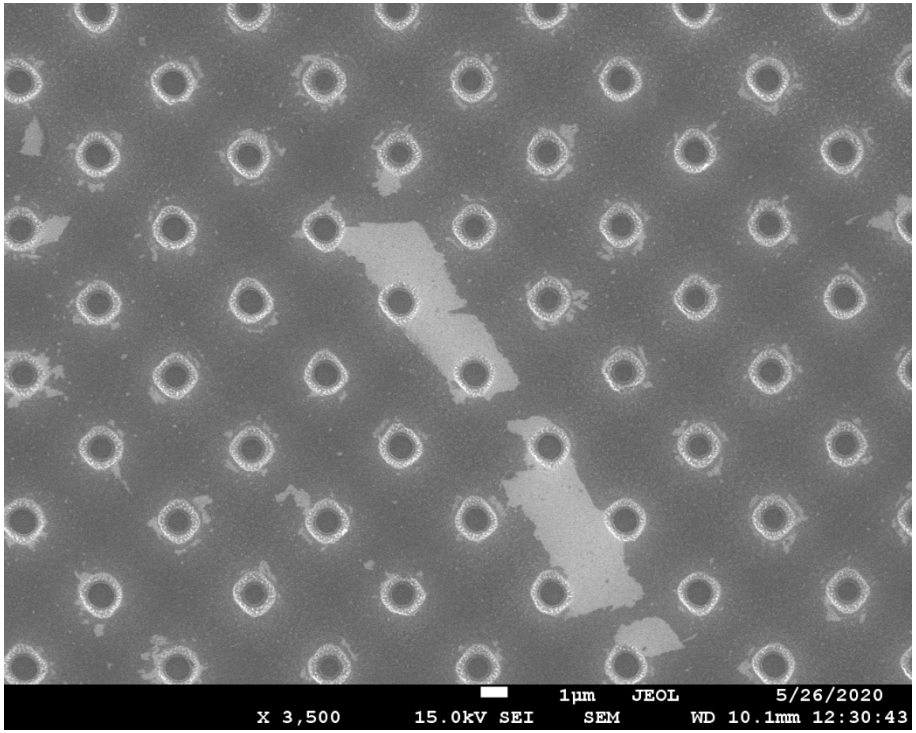
Maskless Photolithography: Heidelberg Laser Writer Photomask Writing Service

- Resolution >=1um and >=10 um features
- 4 mm writer head for high resolution and 40 mm write head for fast writing



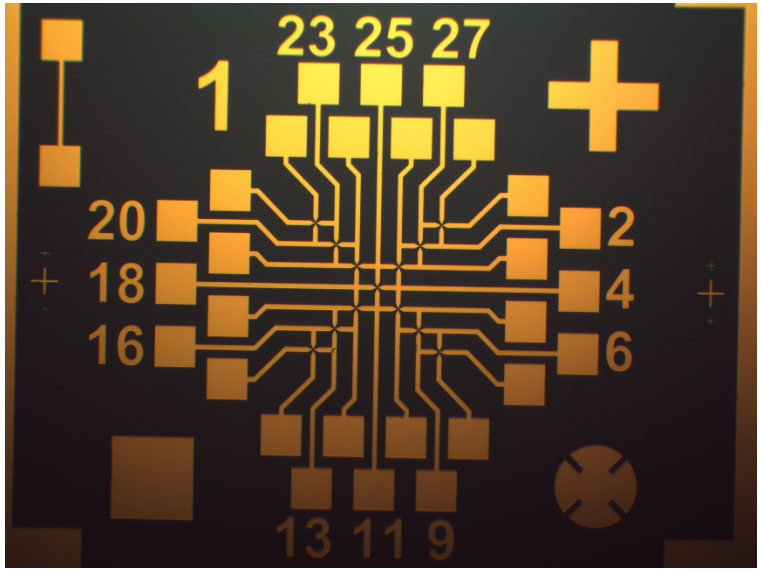
4”x4” Photomasks writing service

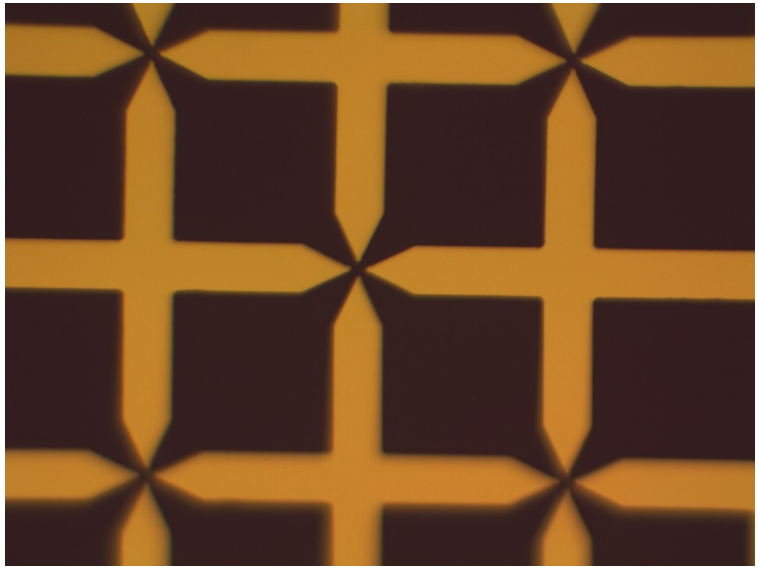
Maskless Photolithography: Heidelberg Laser Writer Photomask Writing Service



Photomask produced in house transfer 1um hole patterns without mask aligner

Maskless Photolithography: Heidelberg Laser Writer Photomask Writing Service





Photomask produced in house transfer 1um feature size
(spacing distance among four contacts)
without mask aligner

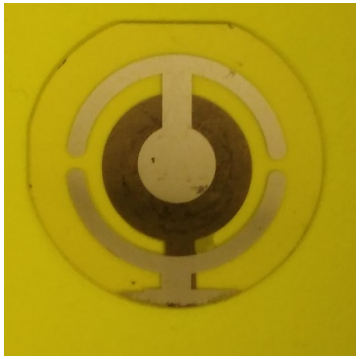
Maskless Photolithography: Heidelberg Laser Writer Photomask Writing Service

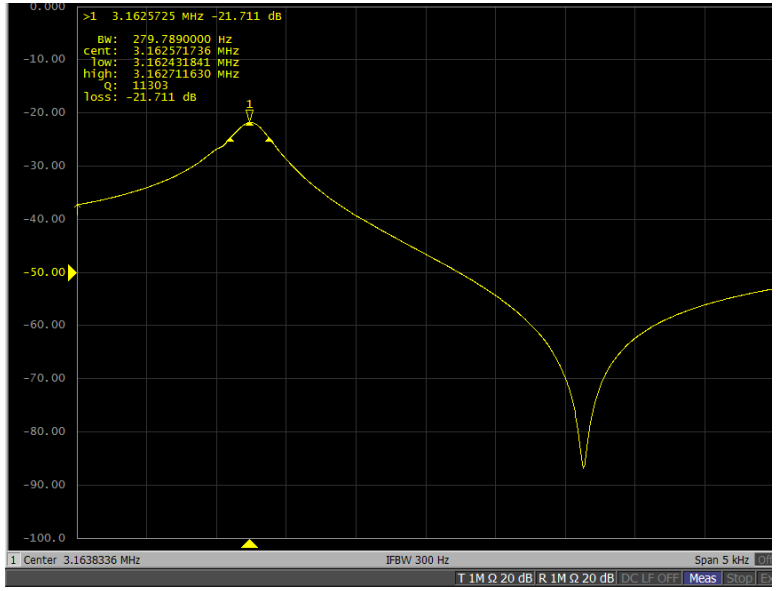
- Resolution >=1um and >=10 um features
- 4 mm writer head for high resolution and 40 mm write head for fast writing

Ag Contact pattern on 1 inch Si wafer

Maskless Photolithography: Heidelberg Laser Writer Pattern Writing Service

- frequency response curve of LGS (Langasite) crystal material for viscosity measurement using BAW (bulk acoustic wave) resonator technique



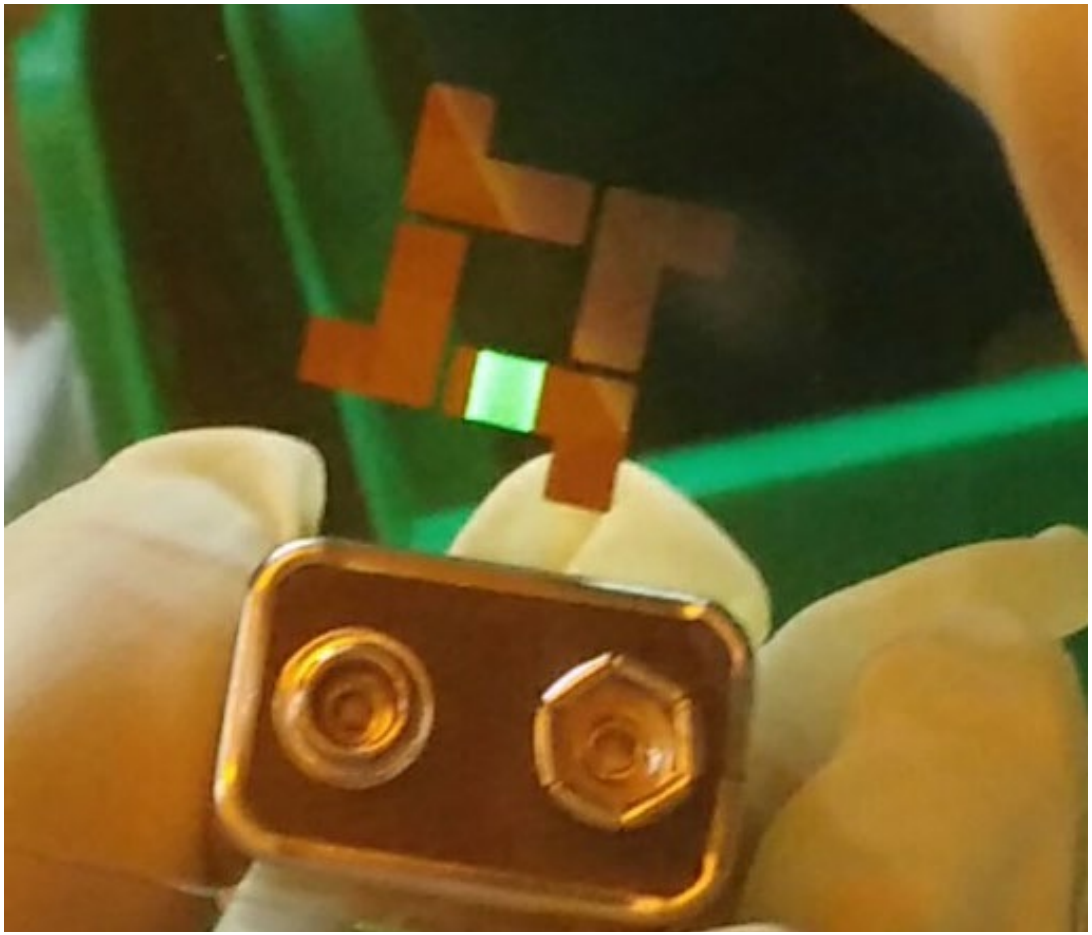


Trovato OLED Deposition System

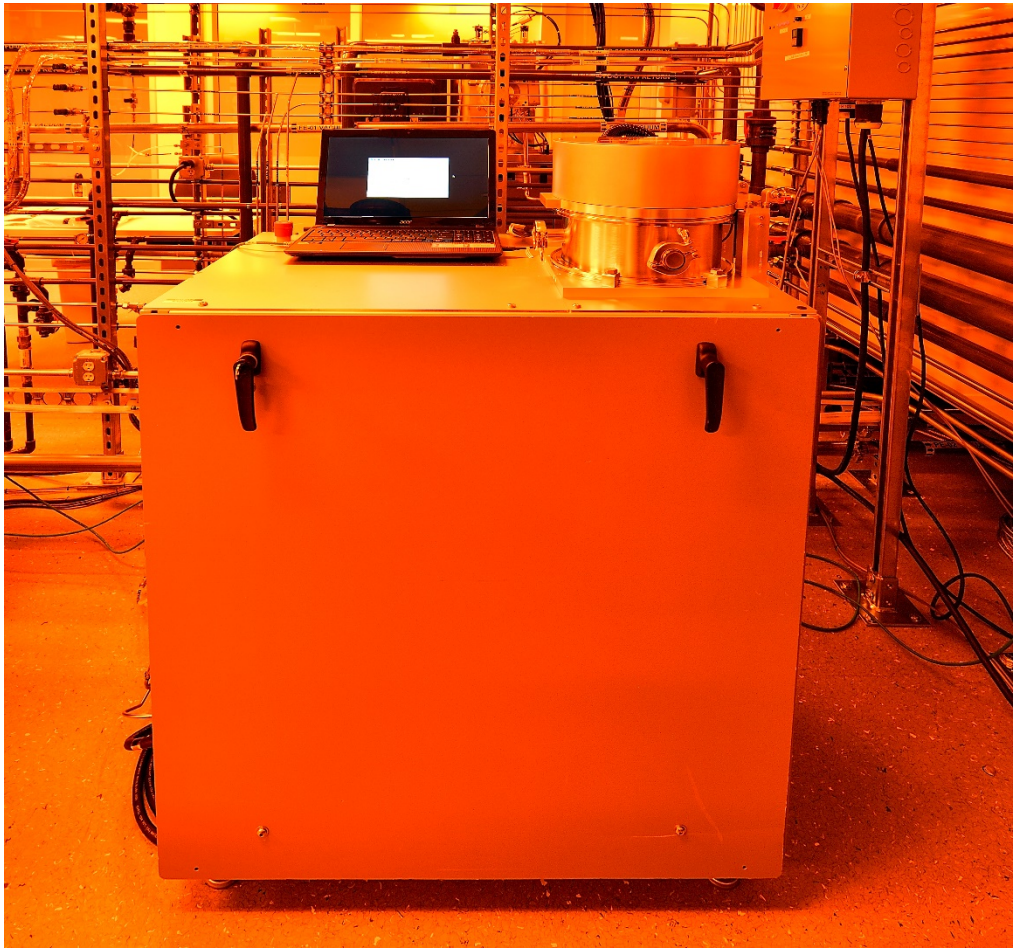
Trovato OLED Deposition System

Al/LiF/AlQ/MBT/ITO

OLED fabrication

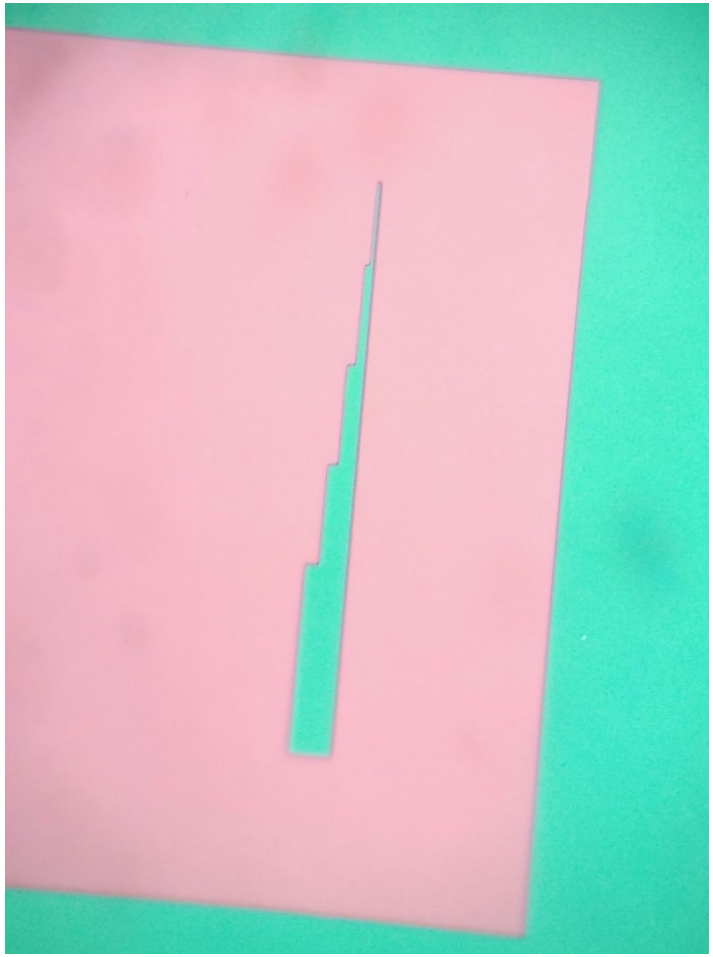


Reactive Ion Etching



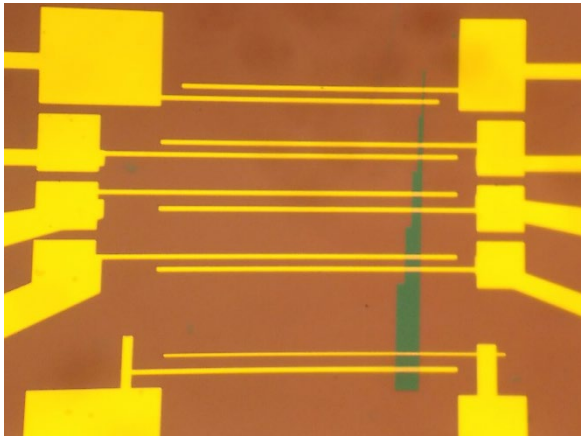
Reactive Ion Etching

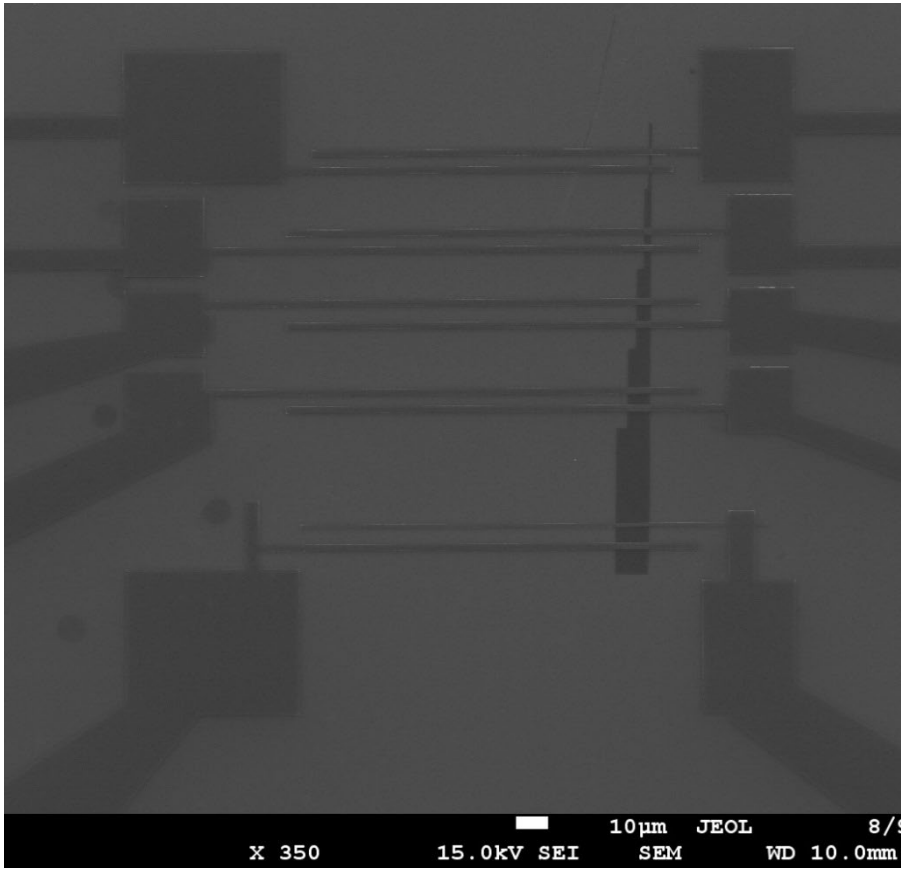
- Etching MoS_2/SiO_2 thin film to Stair shape pattern.
- Blue area is MoS_2. pink area is SiO_2 without MoS_2
- The widths for each stair are: 0.5um, 1.2um,3um, 6um, 11um



Reactive Ion Etching & Contact Patterning

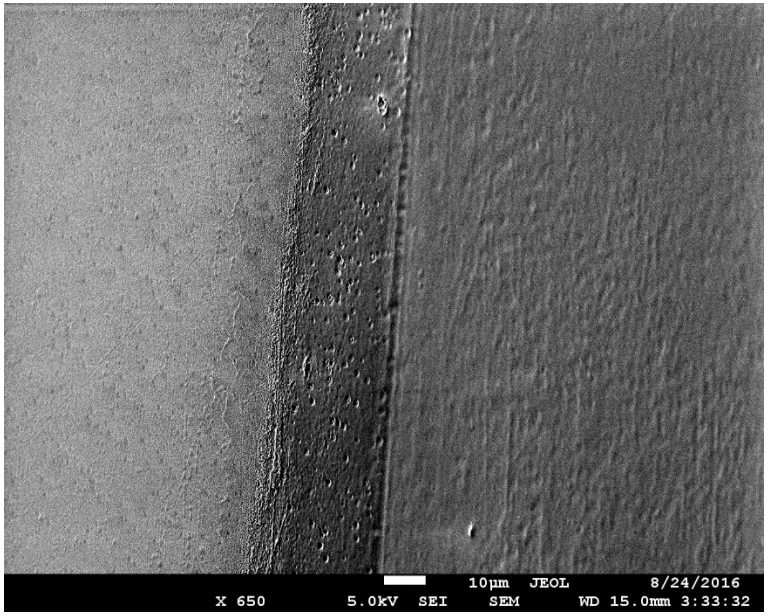
- Patterning the Ag contact on top of the etched MoS2 stairs
- Ebeam evaporator for the Ag contacts

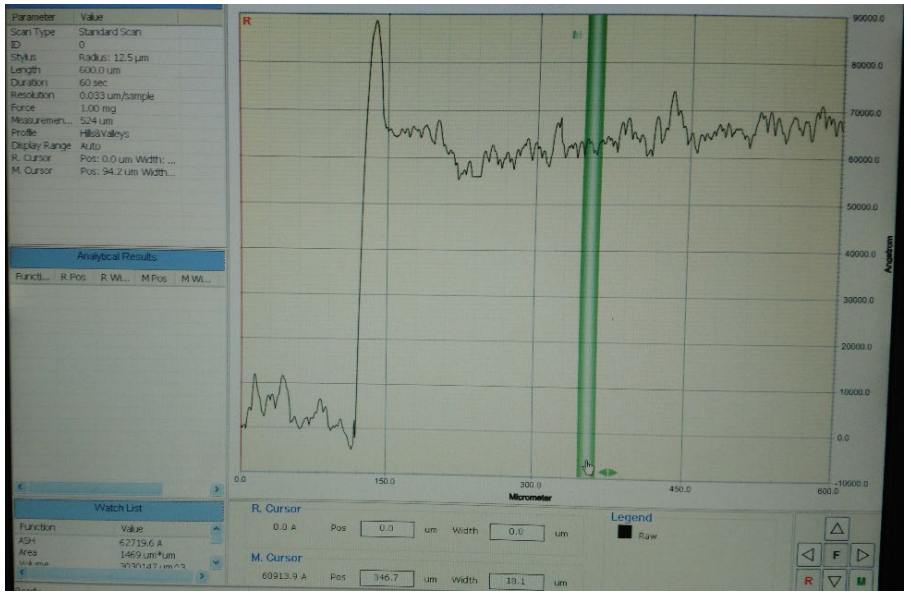




Reactive Ion Etching

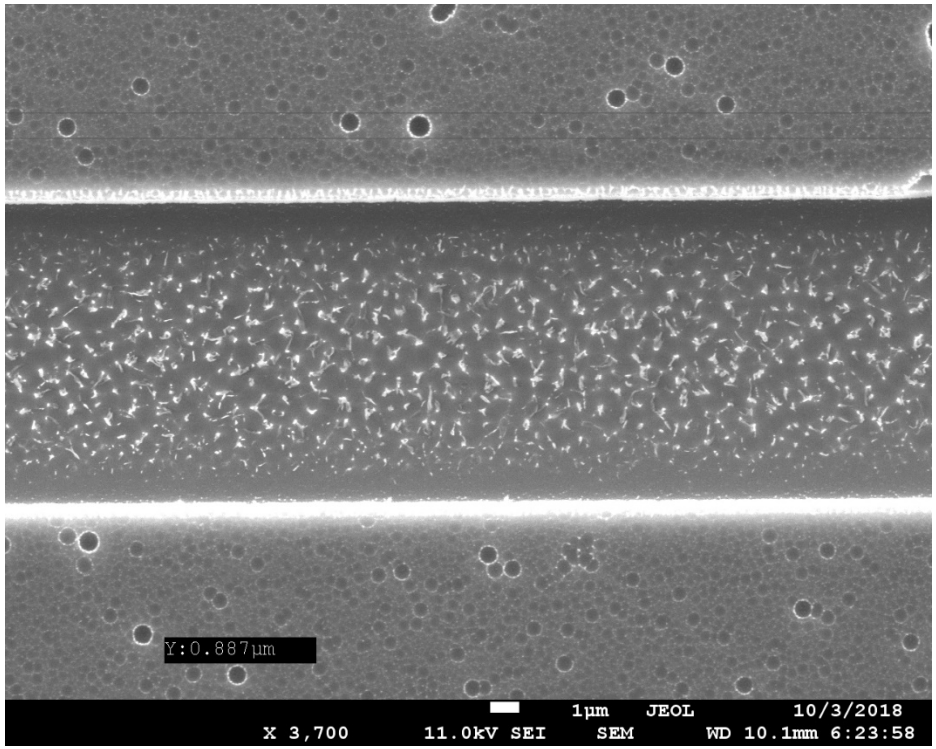
- Etching quartz slide to depth of 6 um or more

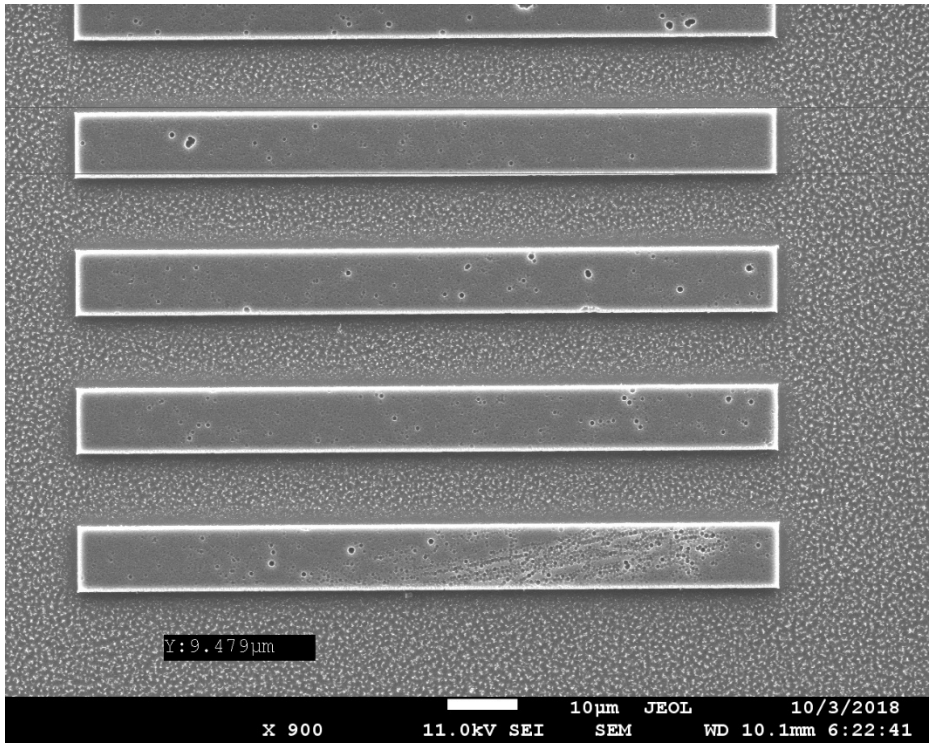




Titled cross section

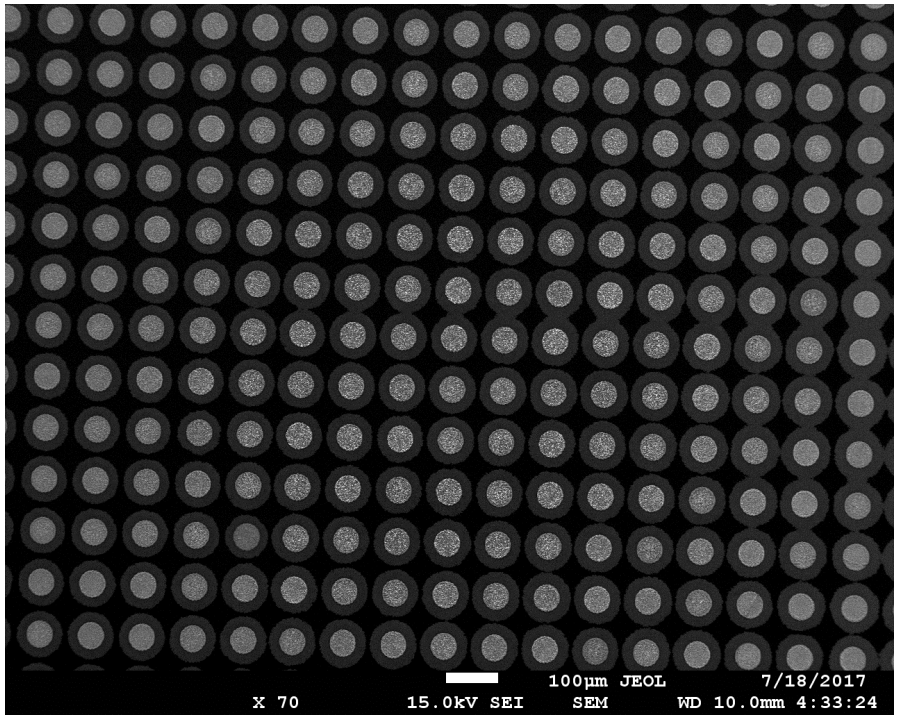
Reactive Ion Etching

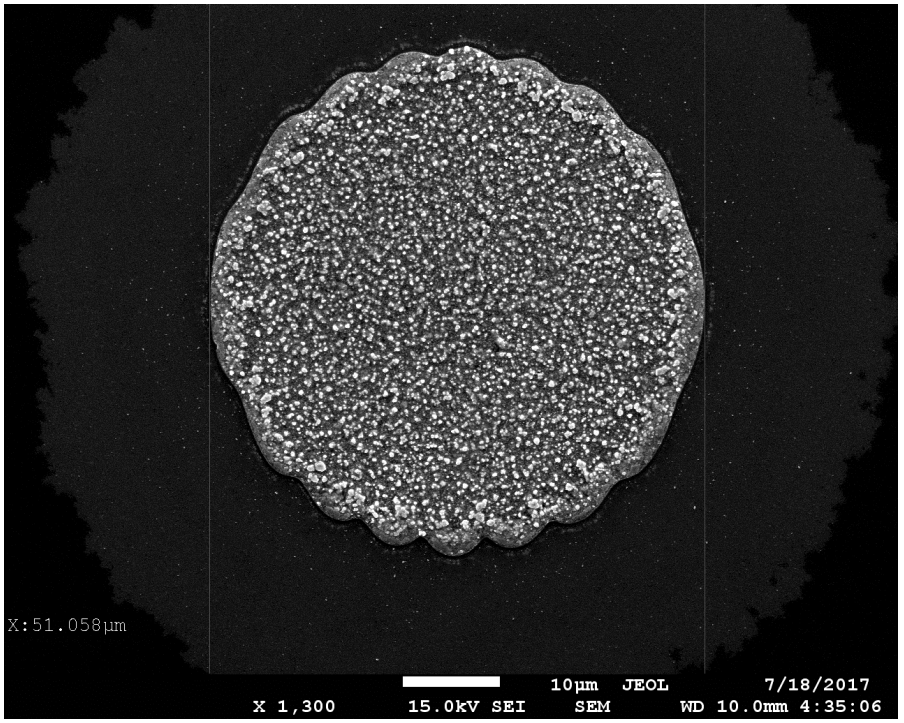




Silicon Etching

Reactive Ion Etching

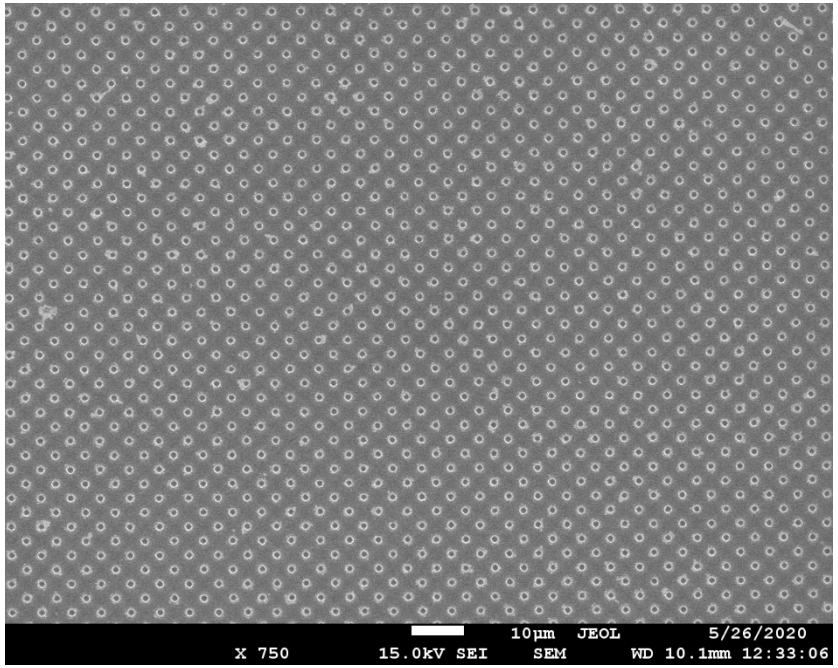


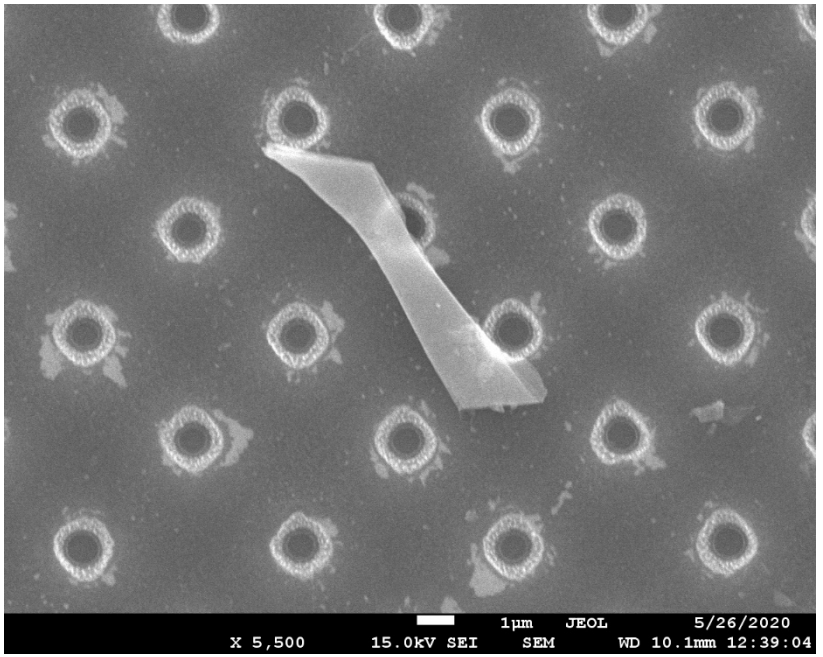


Silicon Etching

Reactive Ion Etching

- Etching SiO2 down to form 1um holes with photomask produced in house. Exposure without mask aligner.





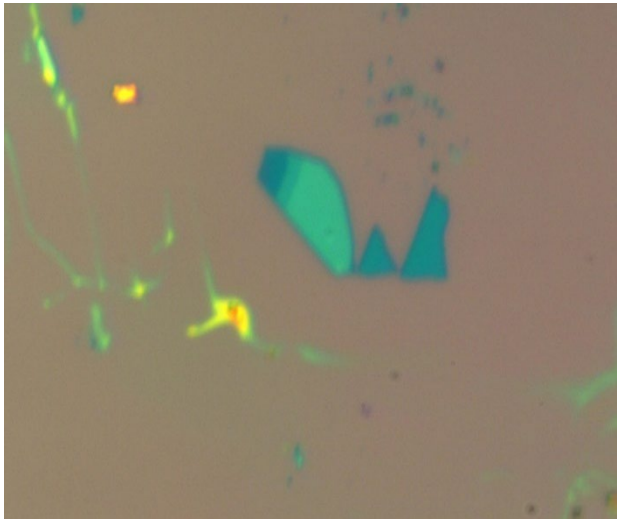
WS2 flake suspended over holes

Back-gated FETs from MoTe2 flakes

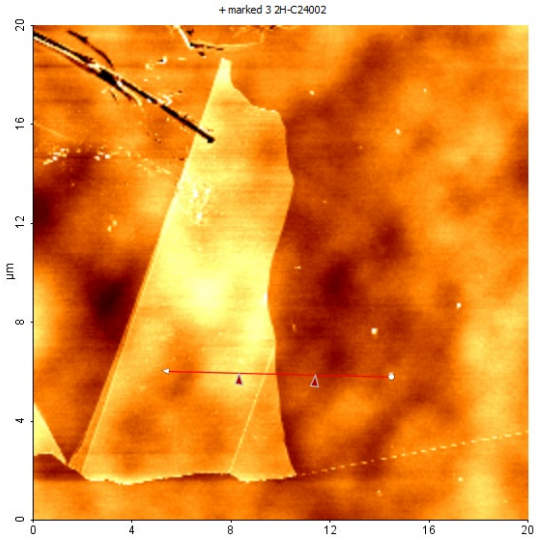
Ben Sirota

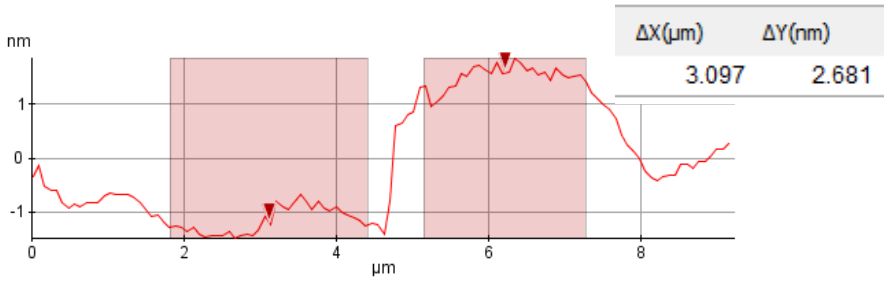
Materials Science and Engineering

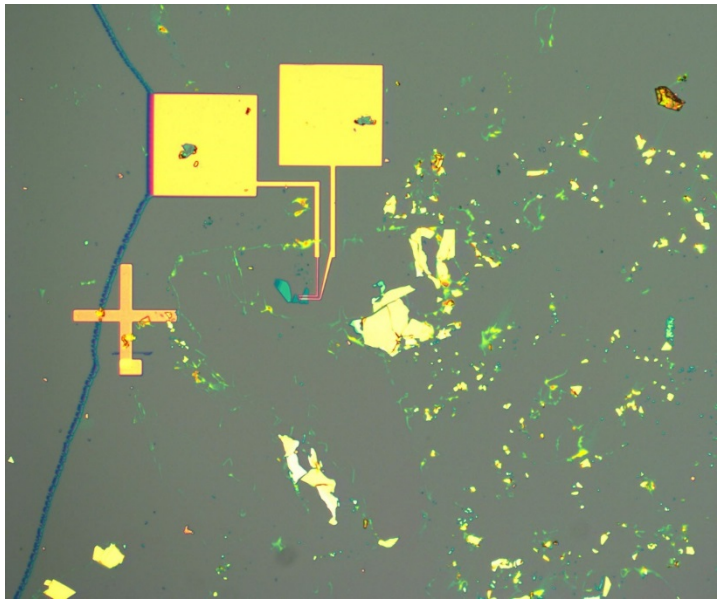
MoTe2 flakes were exfoliated from bulk crystals on silicon substrates with a 300 nm SiO2 layer. Flakes were identified using optical microscope.

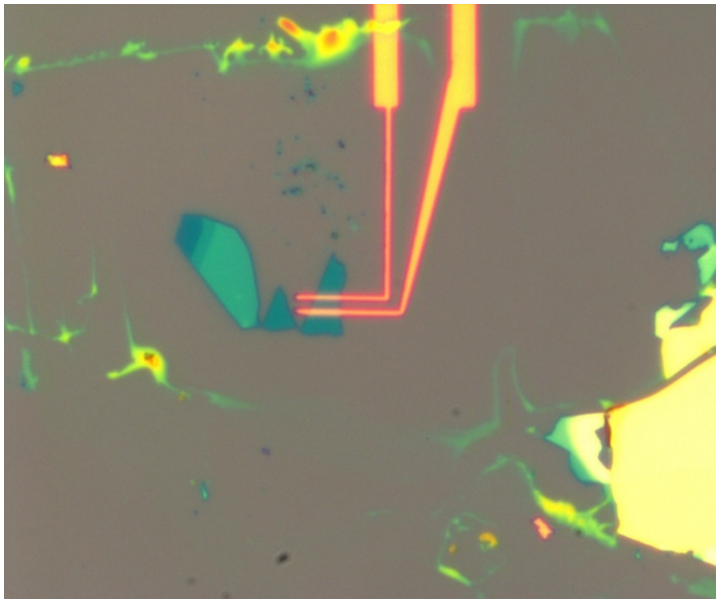


Flake size and thickness was confirmed using AFM. In this case, the thickness was measured as 2.681 nm which is about 3 atomic layers.

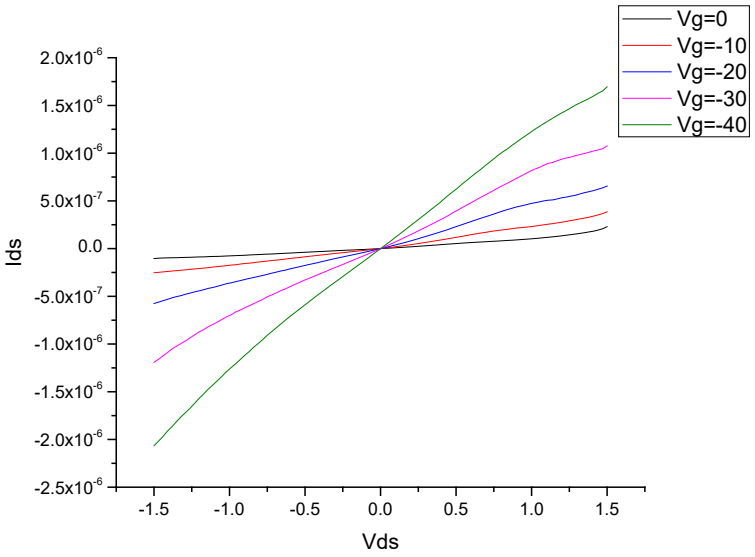




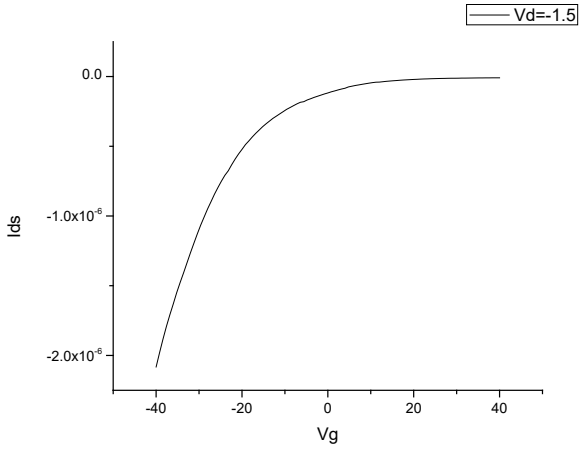




Electrical contacts where designed and written using electron beam lithography. Ti/Au (5/20 nm) metal contacts where deposited by electron-beam evaporation and lift-off. The two deposited contacts form the source and drain while the silicon substrate is used as the gate electrode. Finally, the SiO2 insulative layer acts as a dielectric layer. Therefore these devices are known as back-gated field effect transistors.

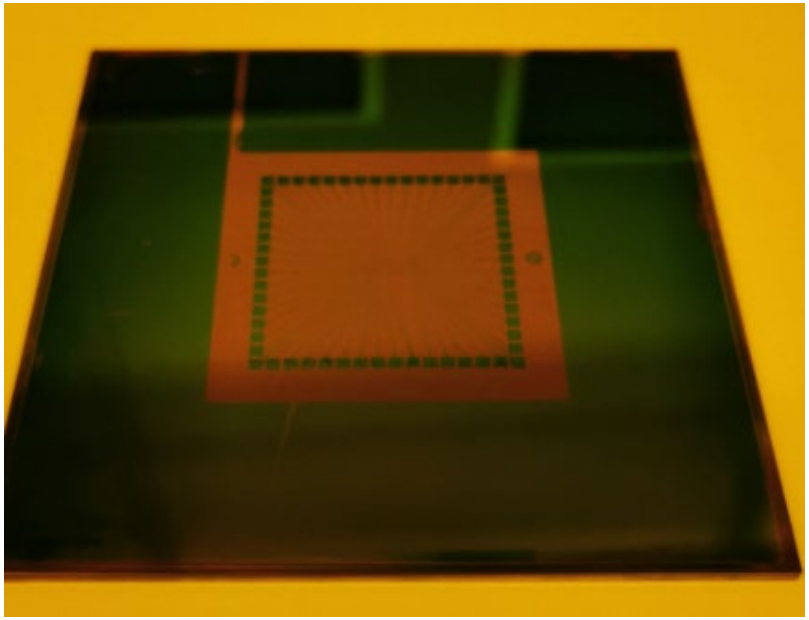


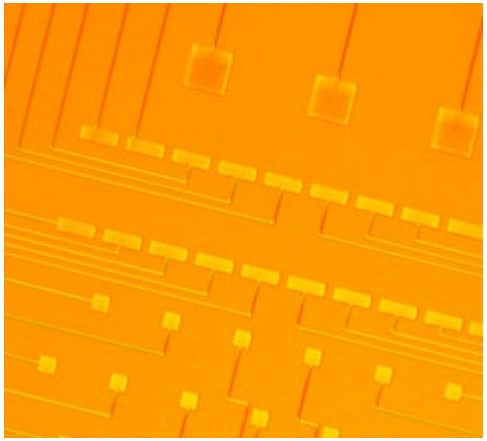
2H-C24
3-2
+M4



Electrical properties where measured using a voltmeter and probe station. The exfoliated flakes demonstrate very responsive FET properties with a high on/off ratio. The MoTe2 flake exhibits p-type semiconductor behavior.

External User Application





Photomasks fabrication for
UT-Dallas, Dr. Joseph Pancrazio