

UNT MRF-Nanofabrication Cleanroom (NFCR)

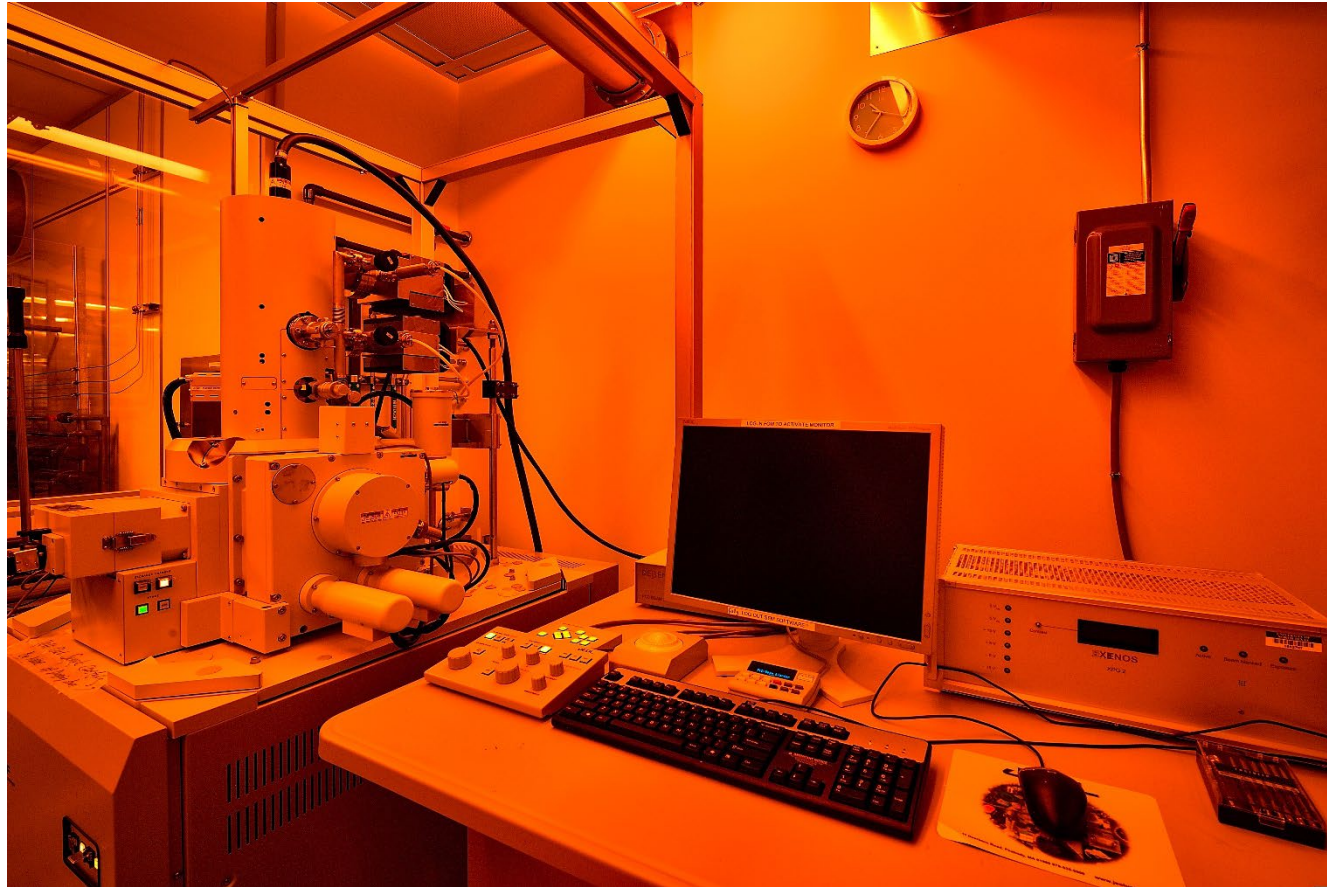


Capacity update. Jan,2022

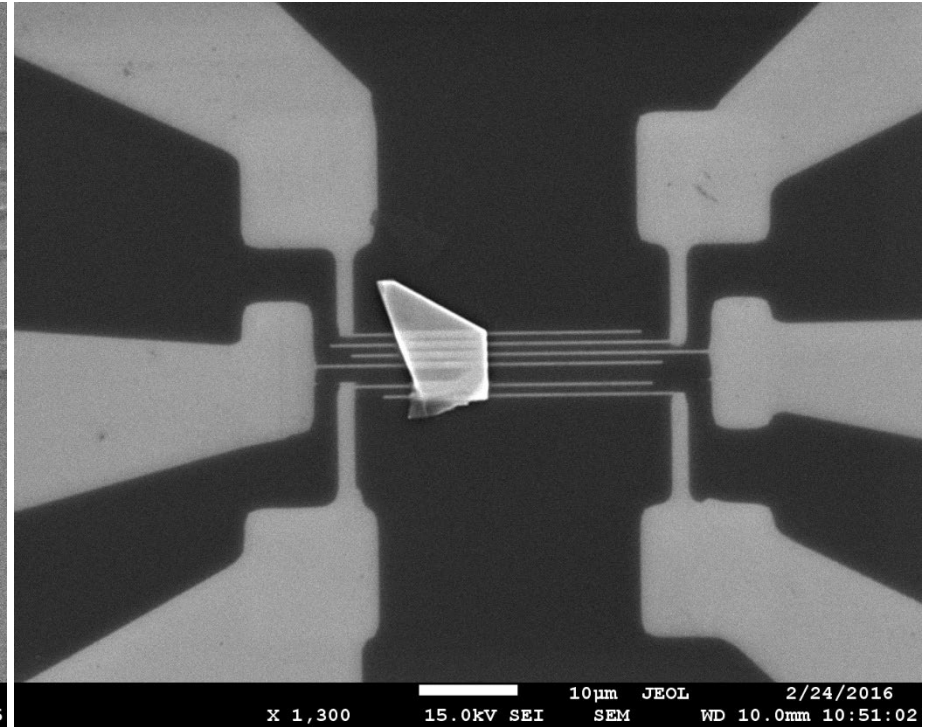
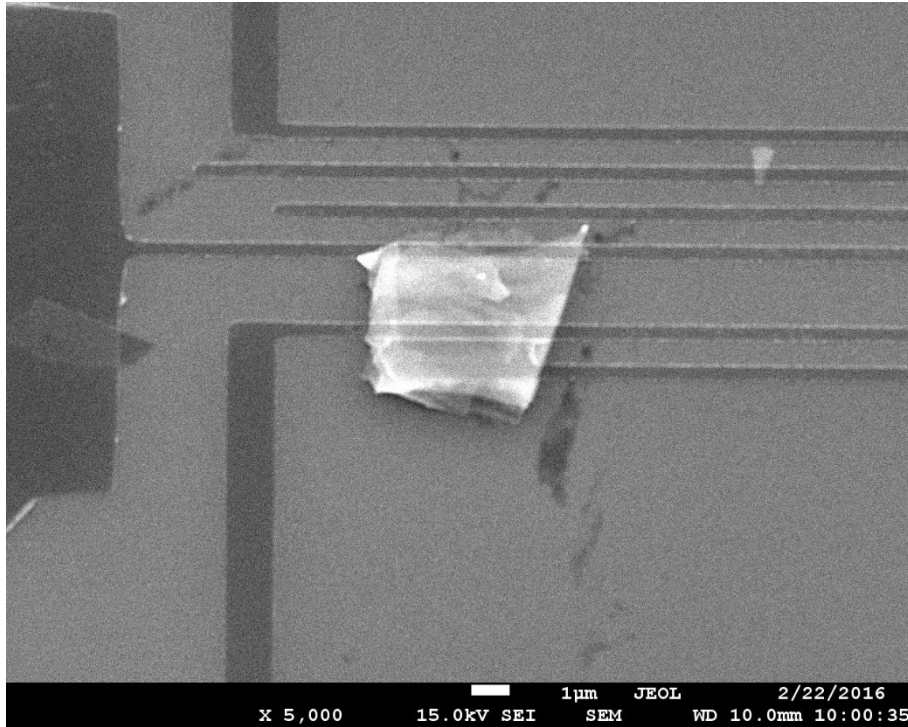
Cleanroom Capacity Update

- 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

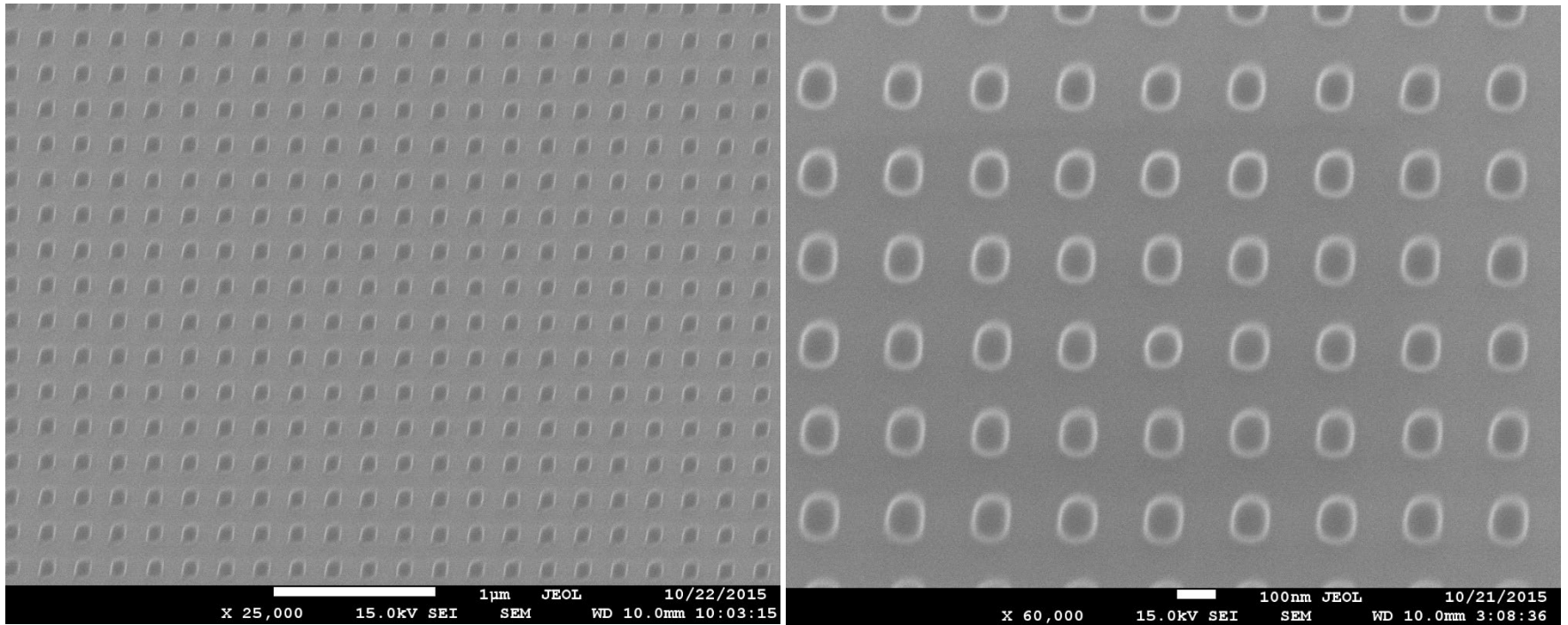


Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator



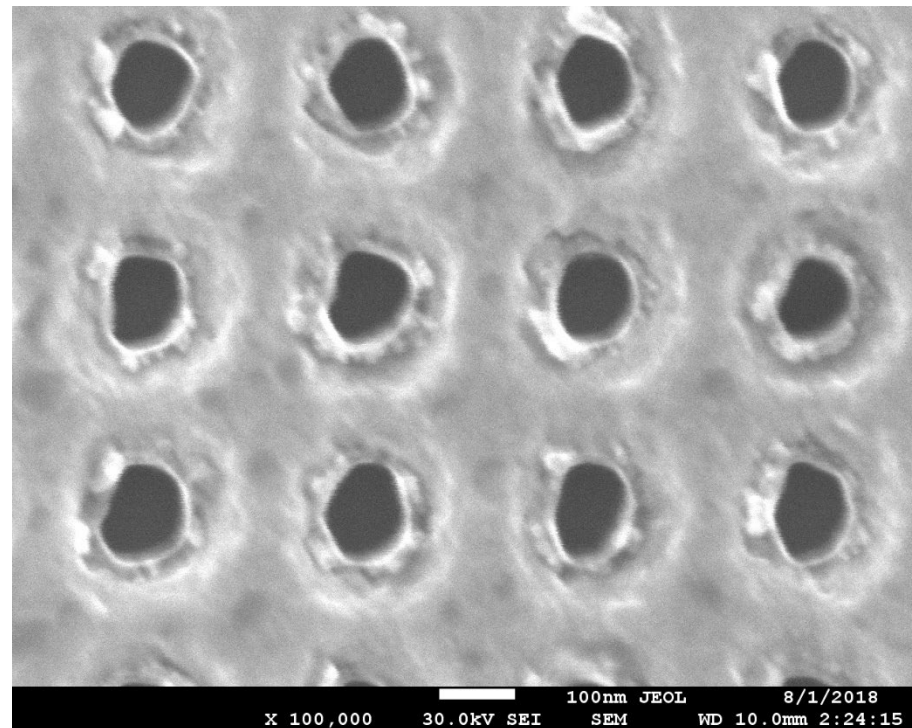
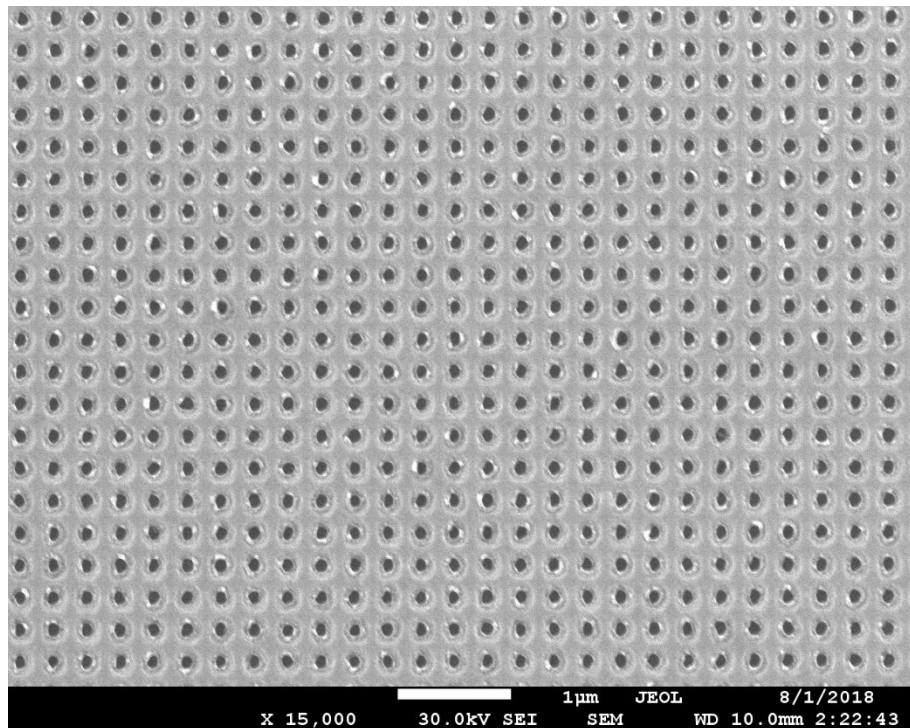
Contact patterns on <10 µm MoTe₂ flakes.
After liftoff (left) and after development (right)

Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator



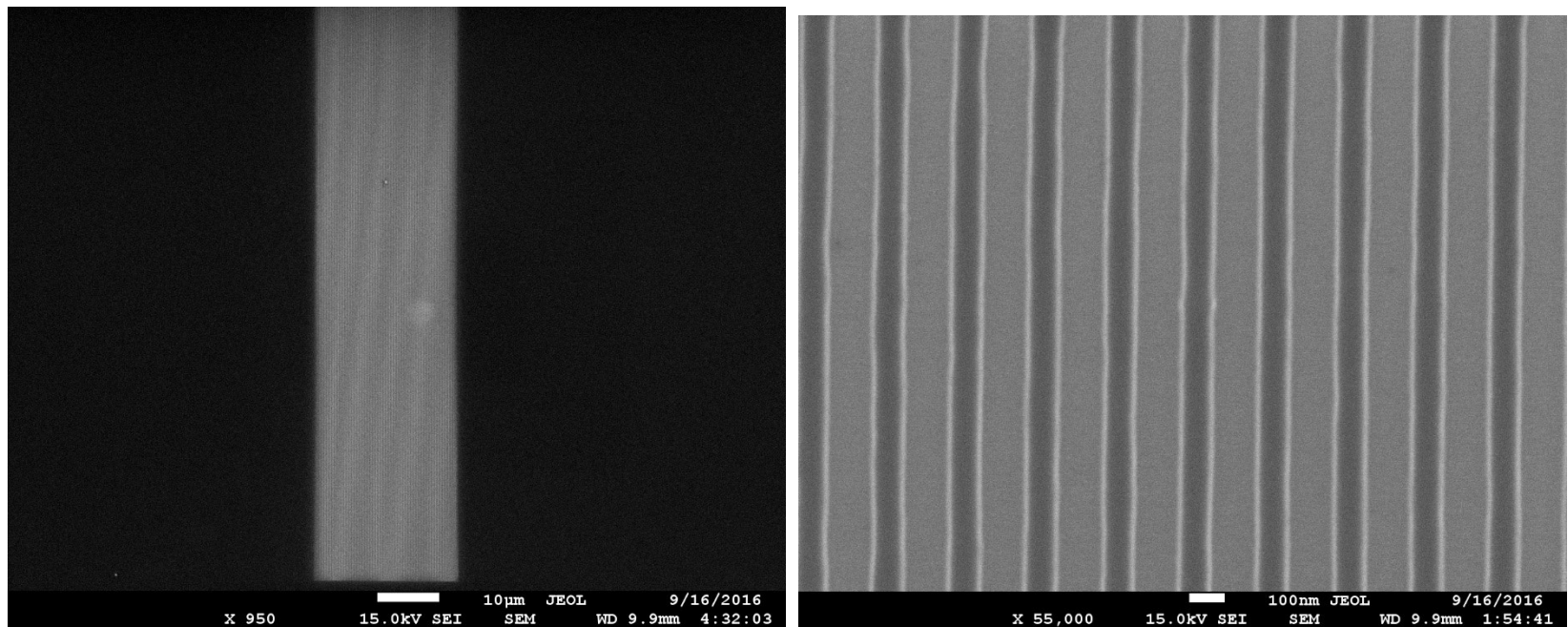
Fishnet pattern after development.
Field size 100 µm and 120x120 nm grids

Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator



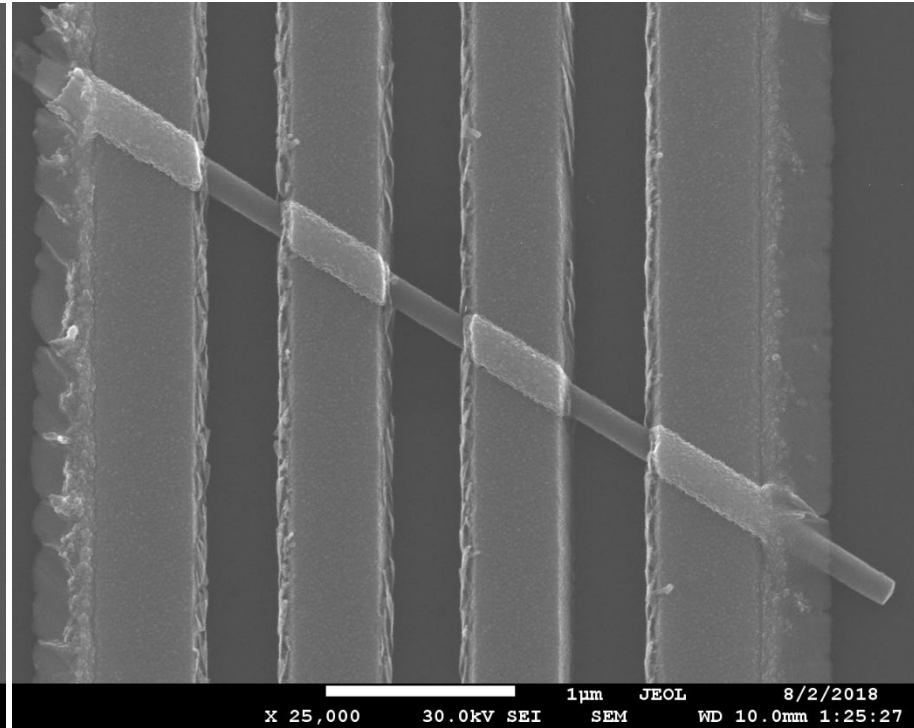
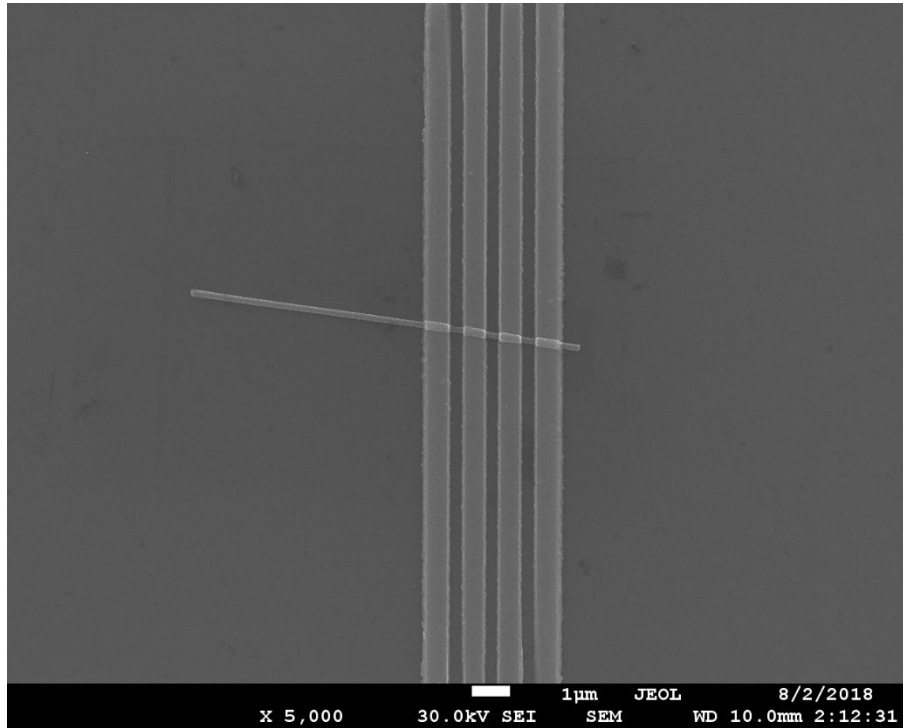
Fishnet pattern after deposition of Ag/Al₂O₃ multilayers and lift off.
Field size 100 µm and 120x120 nm grids

Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator



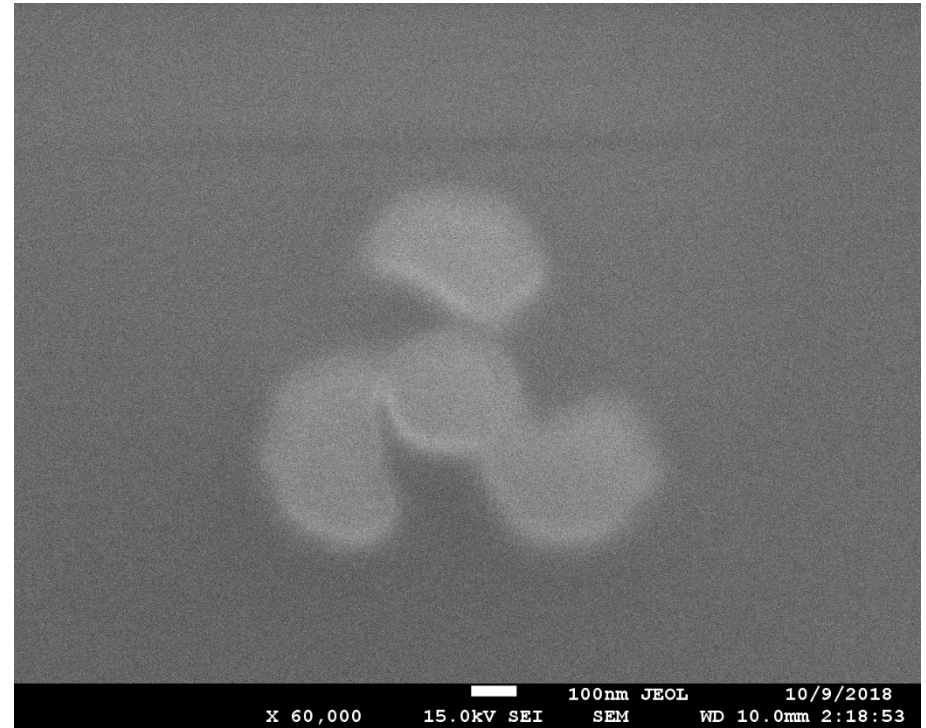
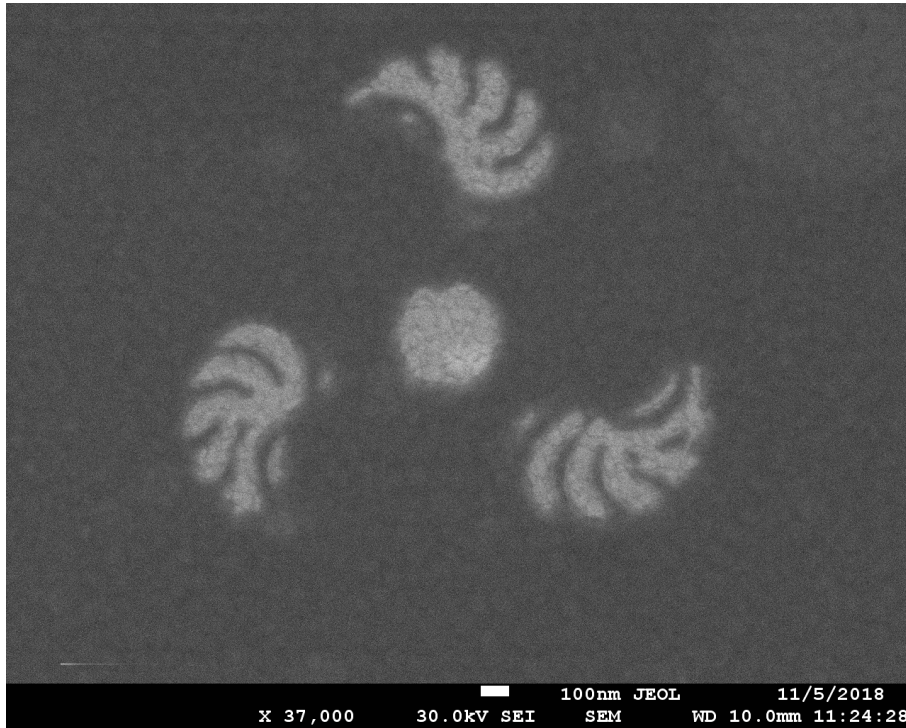
Line patterns for graphene etching.
Field size 100 um and 100 nm lines and 100 nm gaps.

Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator



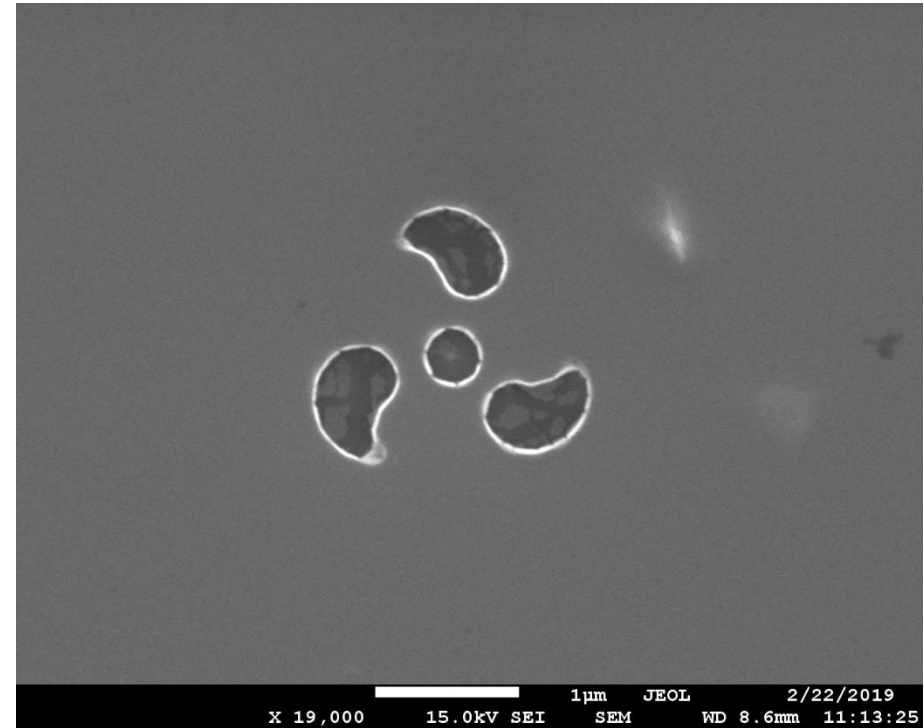
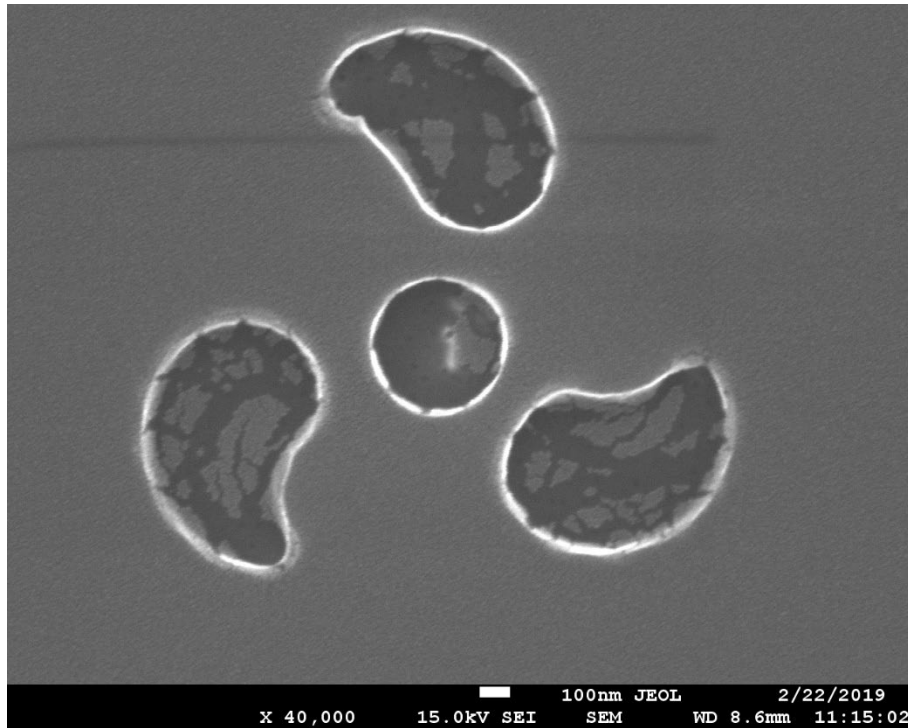
nanowire contact patterning.

Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator



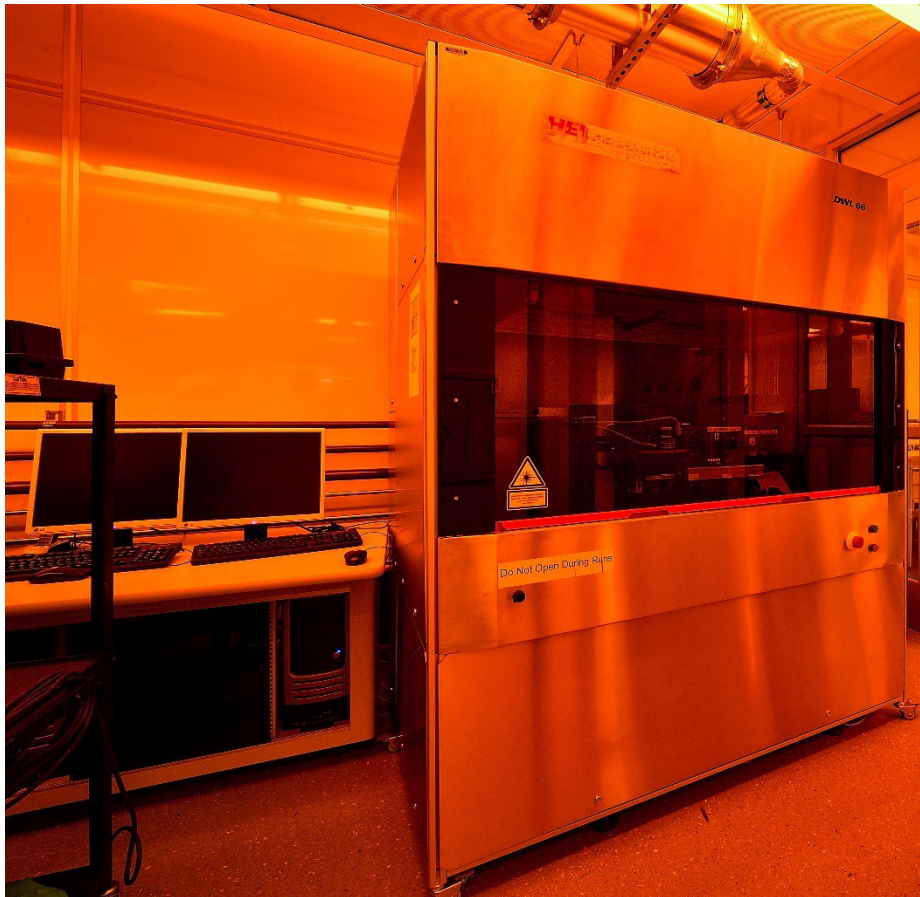
Yin-yang pattern

Ebeam Lithography: JEOL 7001 SEM & XPG Pattern Generator



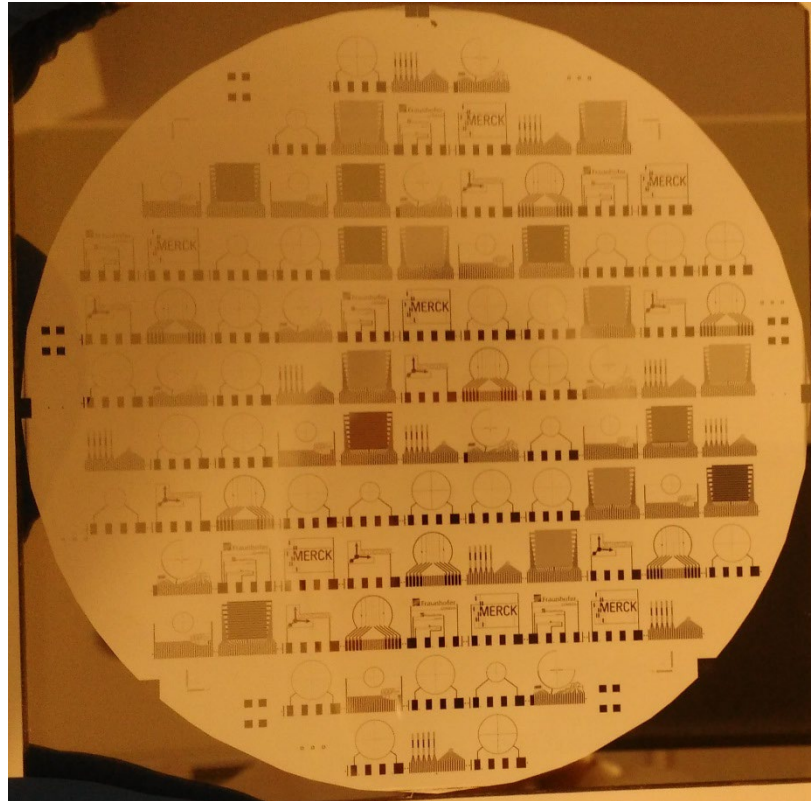
Yin-yang pattern on glass after development

Maskless photolithography: Heidelberg Laser Writer Chemical Processing Stations



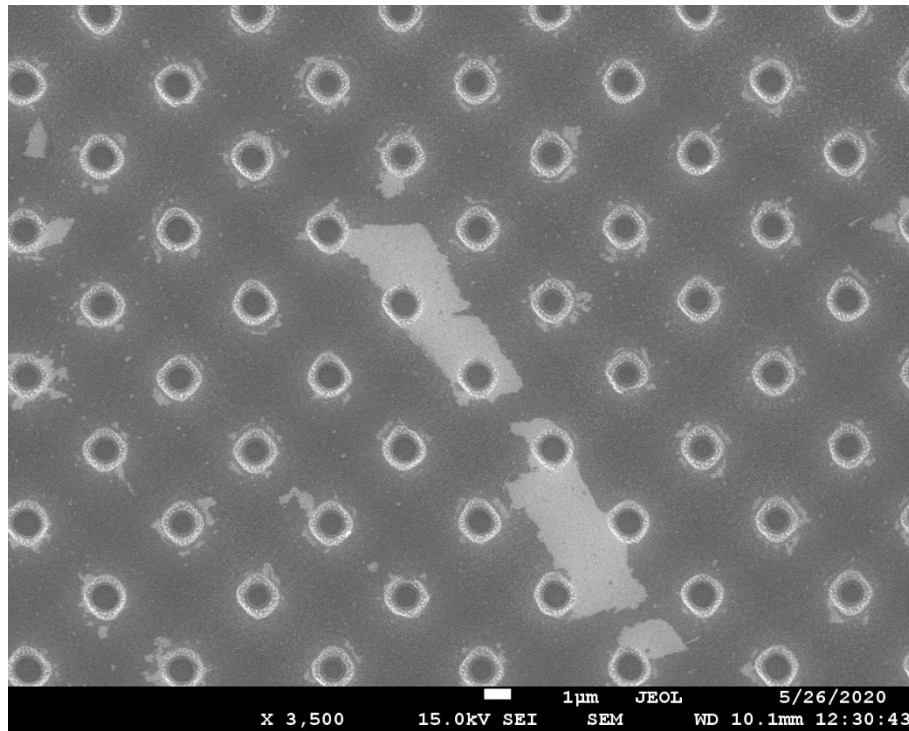
Maskless Photolithography: Heidelberg Laser Writer Photomask Writing Service

- Resolution $\geq 1\mu\text{m}$
and $\geq 10\mu\text{m}$ features
- 4 mm writer head for
high resolution and
40 mm write head for
fast writing



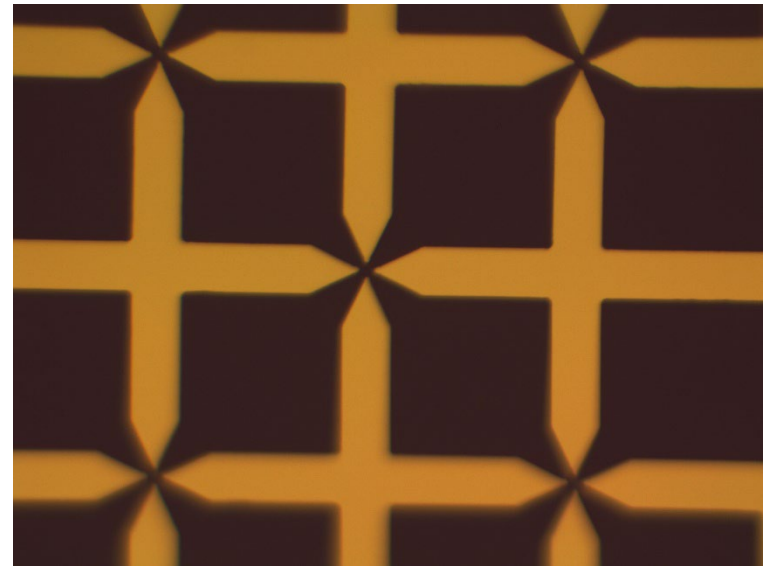
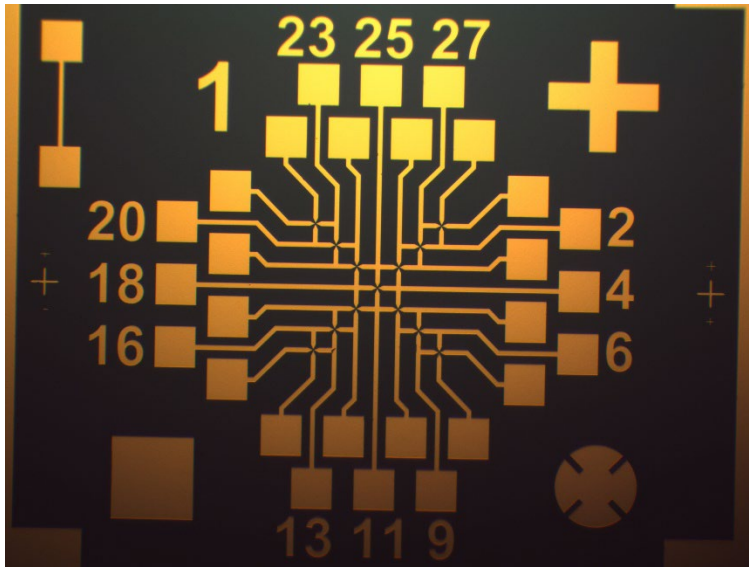
4"x4" Photomasks writing service

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 1μm feature size
(spacing distance among four contacts)
without mask aligner

Maskless Photolithography: Heidelberg Laser Writer Photomask Writing Service

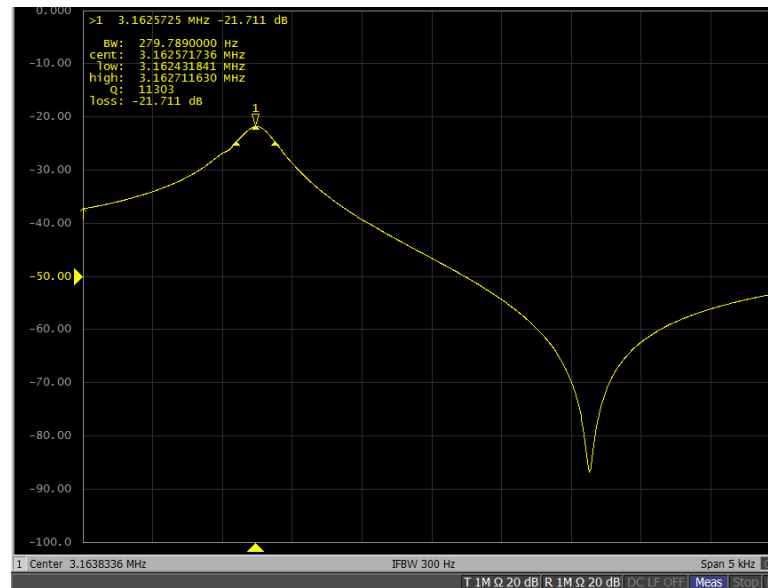
- Resolution $\geq 1\mu\text{m}$ and $\geq 10\mu\text{m}$ features
- 4 mm writer head for high resolution and 40 mm write head for fast writing



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



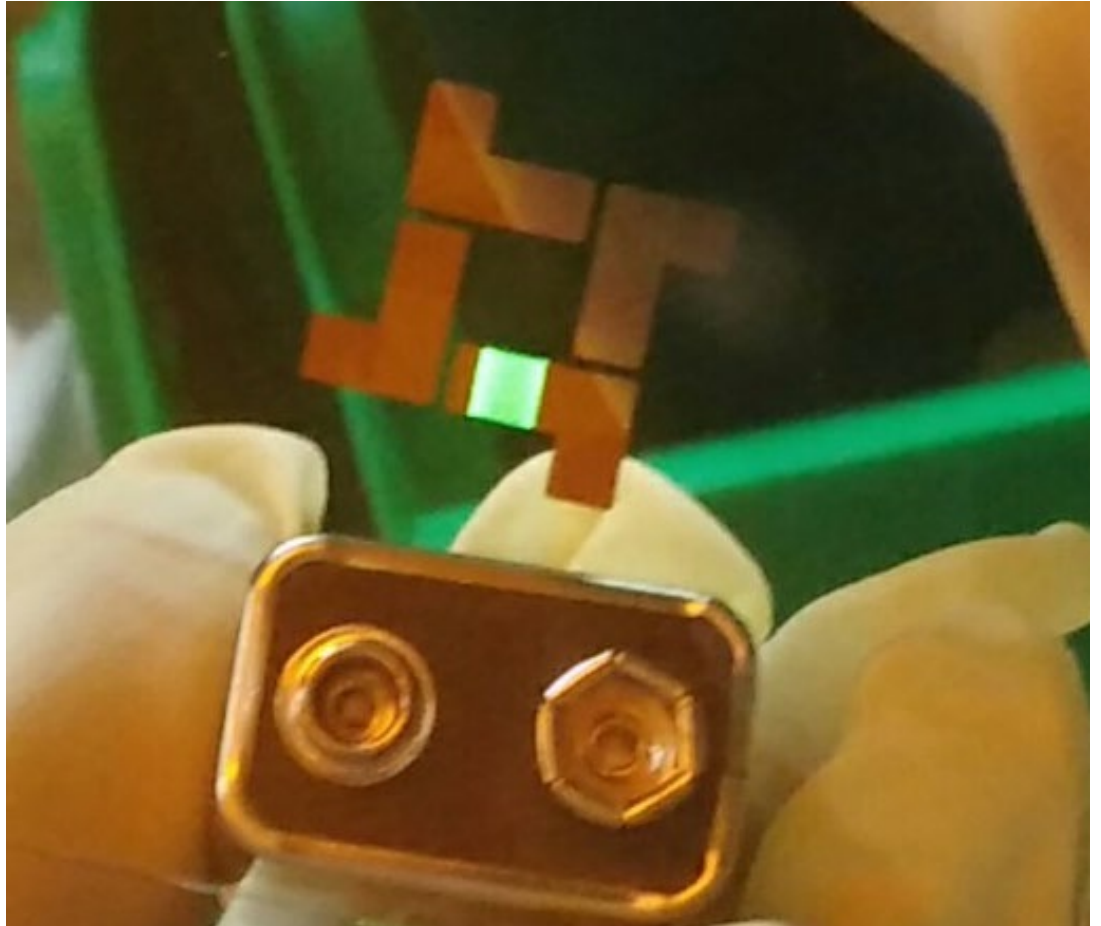
Trovato OLED Deposition System



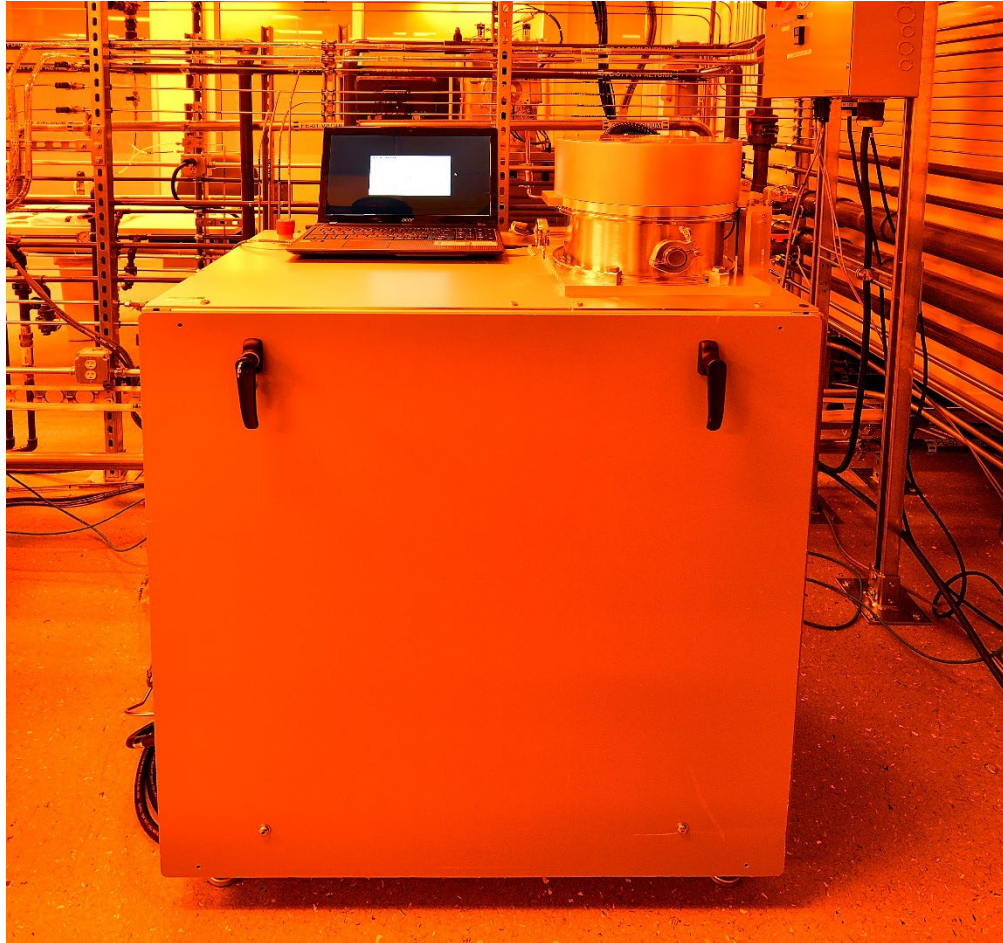
Trovato OLED Deposition System

Al/LiF/AIQ/MBT/ITO

OLED fabrication



Reactive Ion Etching



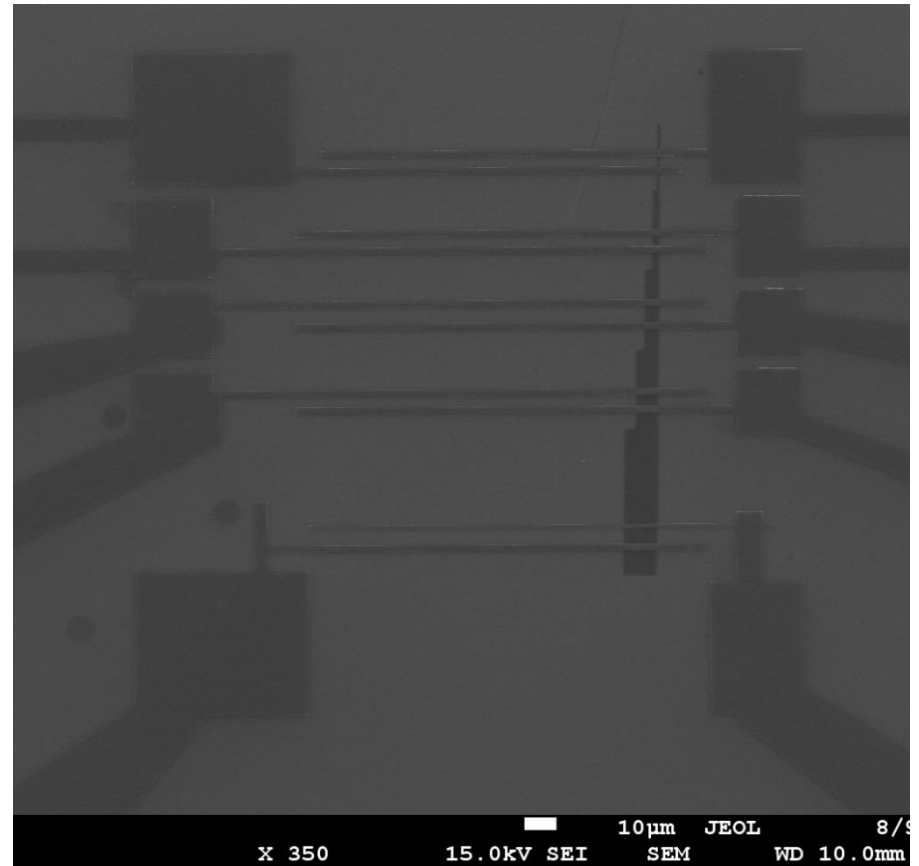
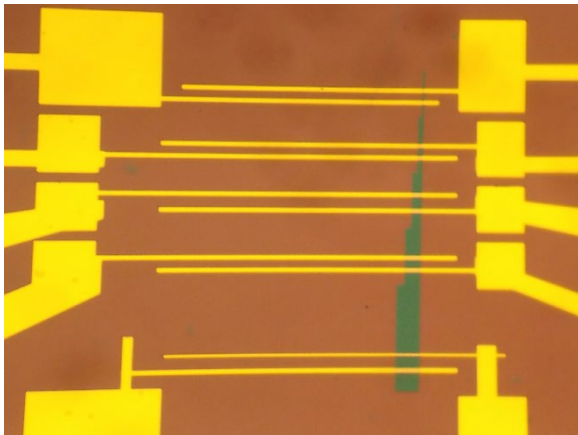
Reactive Ion Etching

- Etching MoS₂/SiO₂ thin film to Stair shape pattern.
- Blue area is MoS₂. pink area is SiO₂ without MoS₂
- The widths for each stair are: 0.5μm, 1.2μm, 3μm, 6μm, 11μm



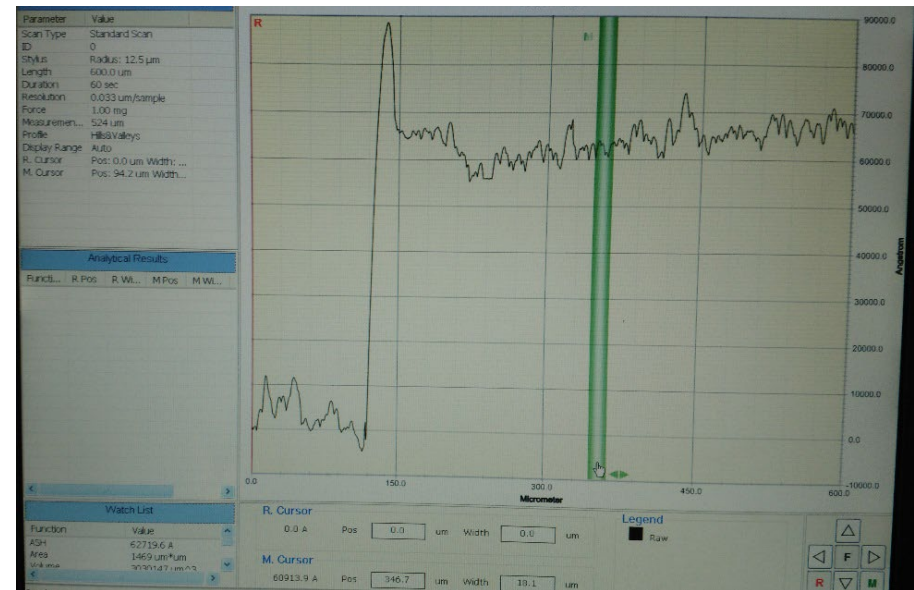
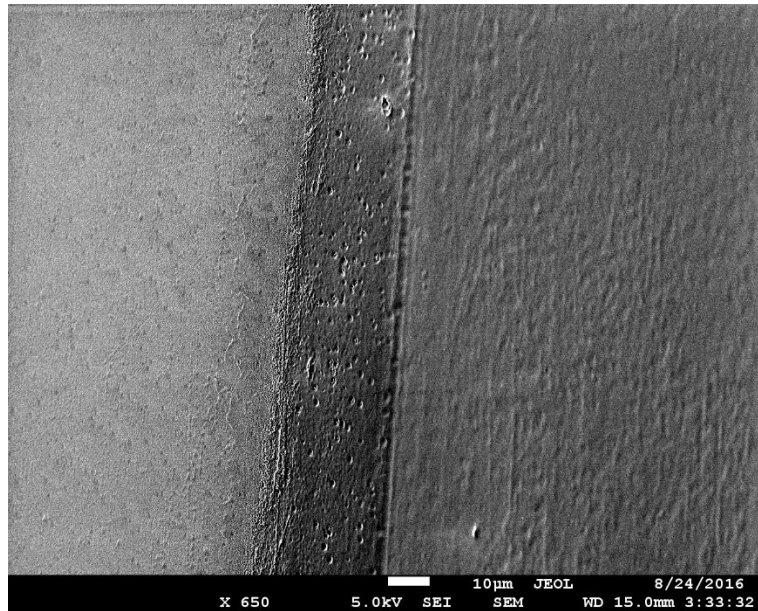
Reactive Ion Etching & Contact Patterning

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



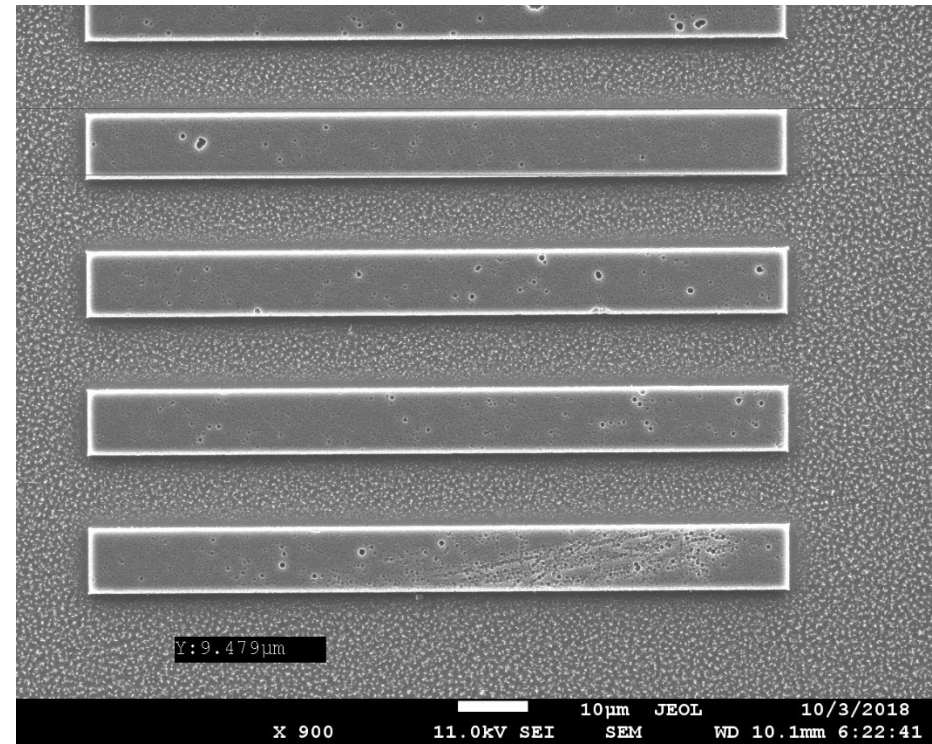
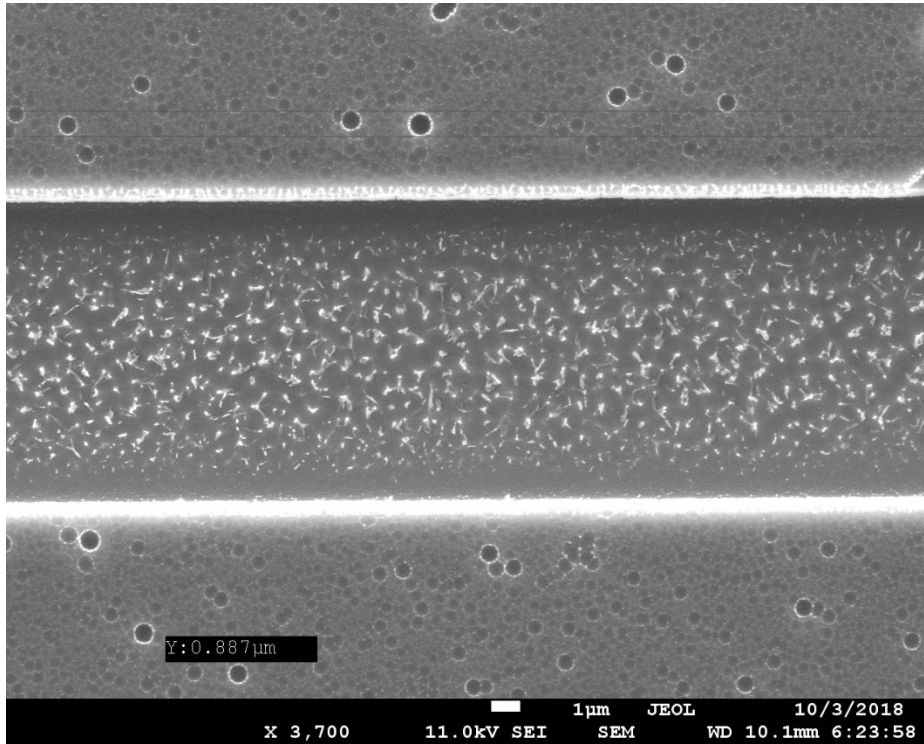
Reactive Ion Etching

- Etching quartz slide to depth of 6 μm or more



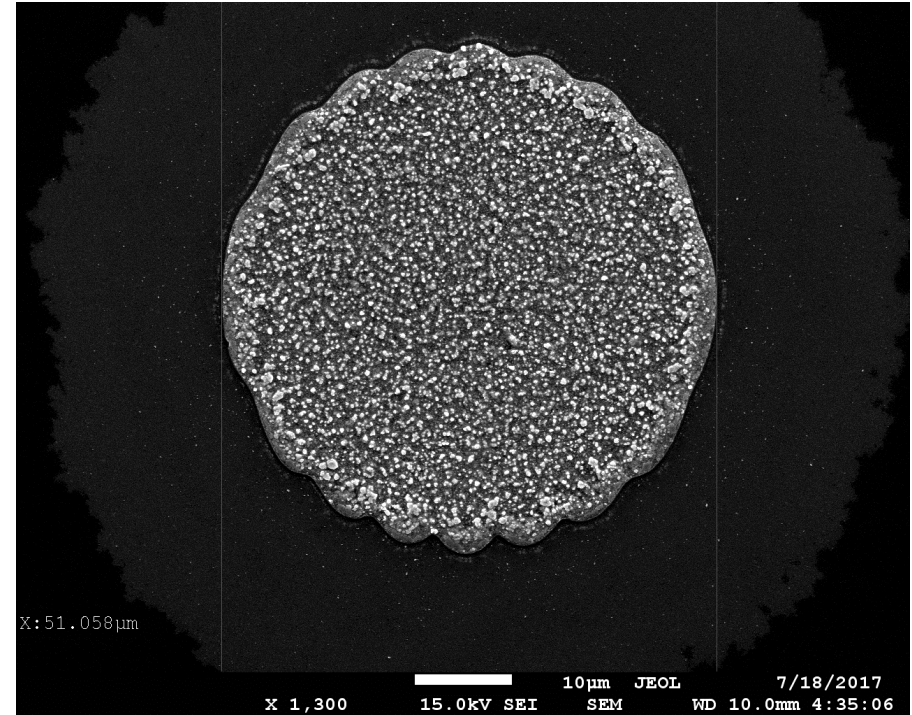
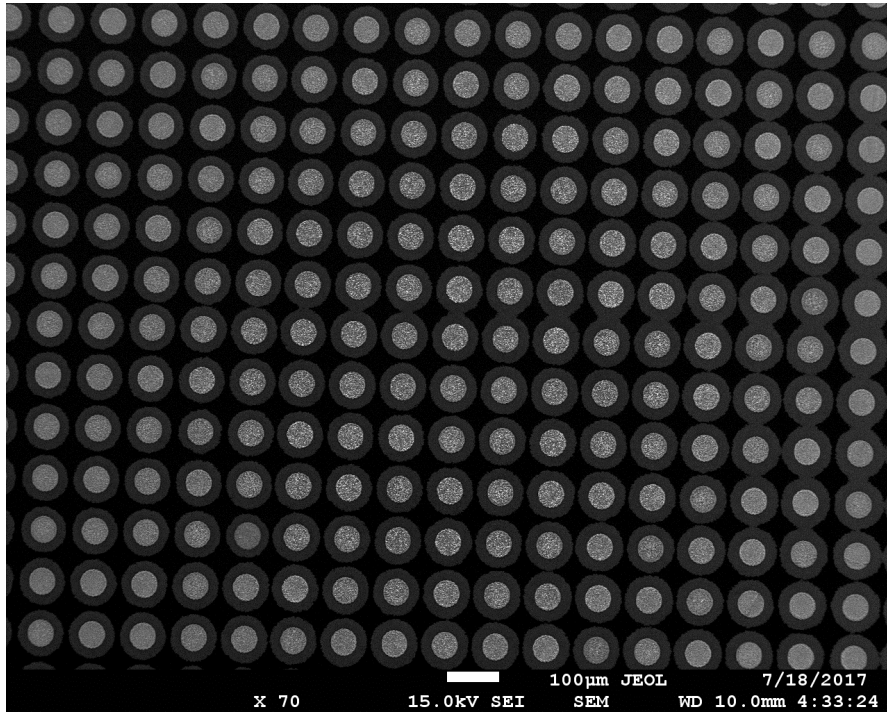
Titled cross section

Reactive Ion Etching



Silicon Etching

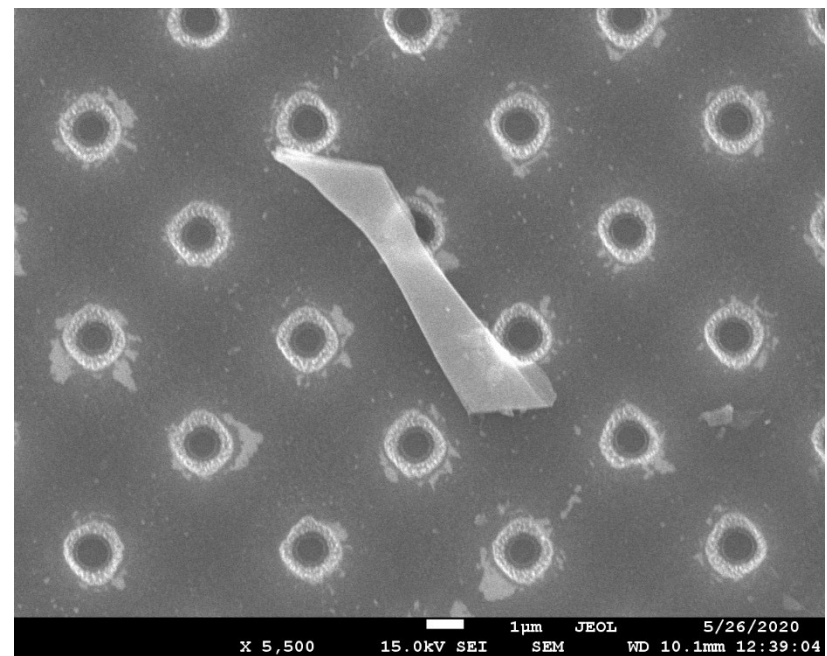
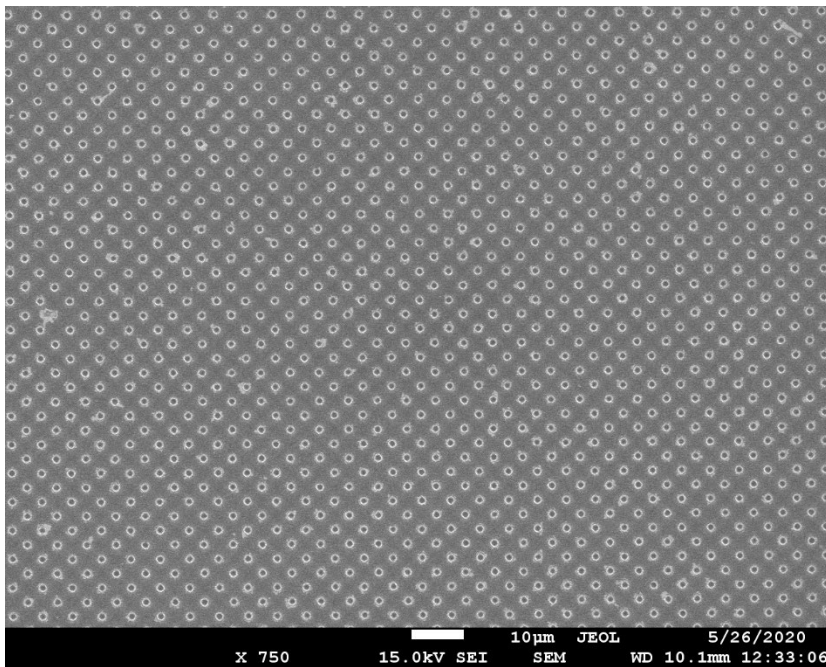
Reactive Ion Etching



Silicon Etching

Reactive Ion Etching

- Etching SiO_2 down to form 1 μm holes with photomask produced in house. Exposure without mask aligner.



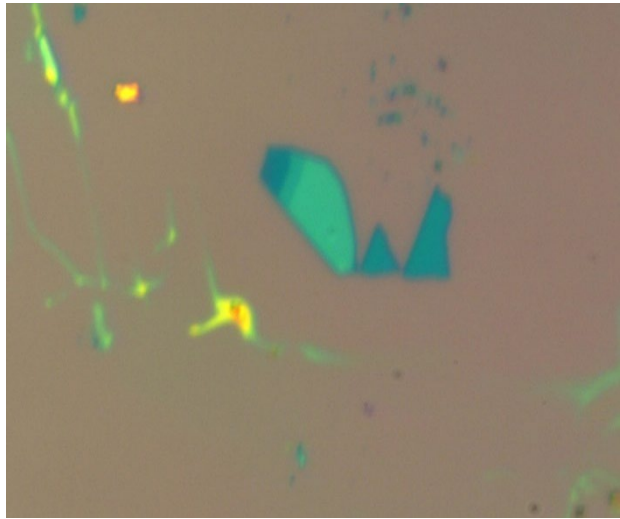
WS₂ flake suspended over holes

Back-gated FETs from MoTe₂ flakes

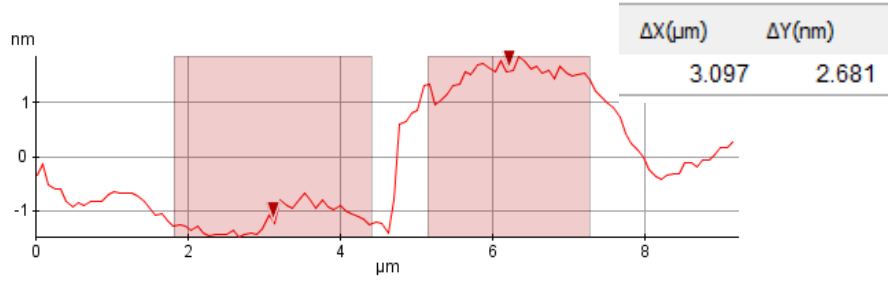
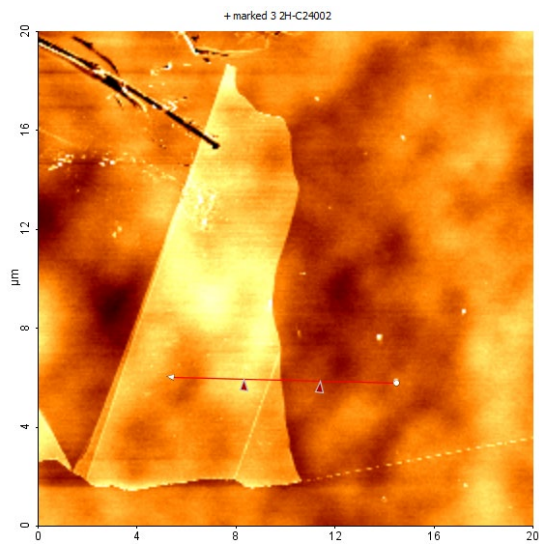
Ben Sirota

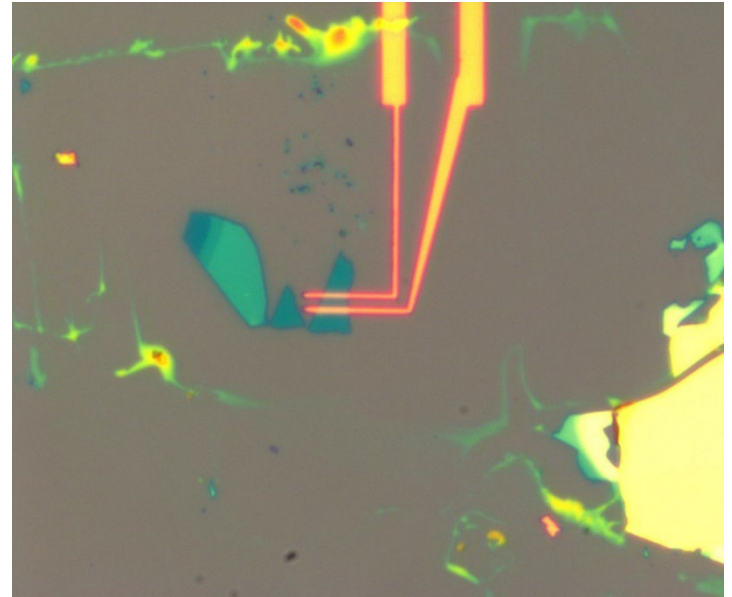
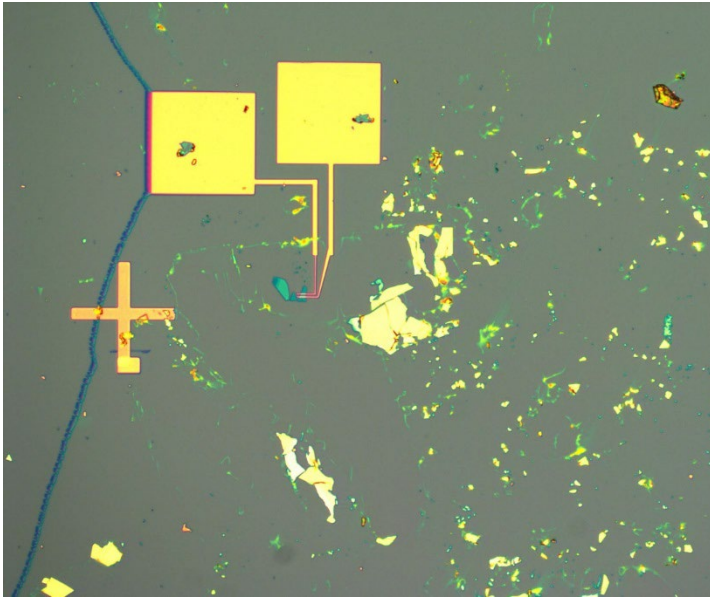
Materials Science and Engineering

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

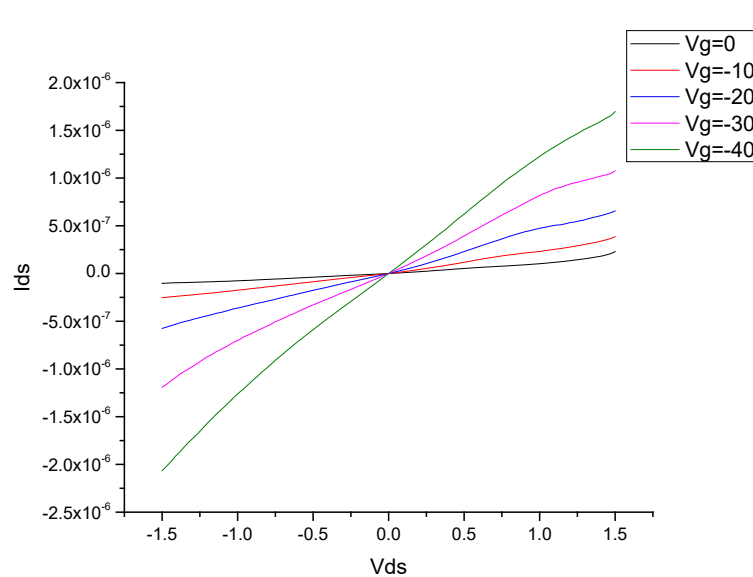


Flake size and thickness was confirmed using AFM. In this case, the thickness was measured as 2.681 nm which is about 3 atomic layers.

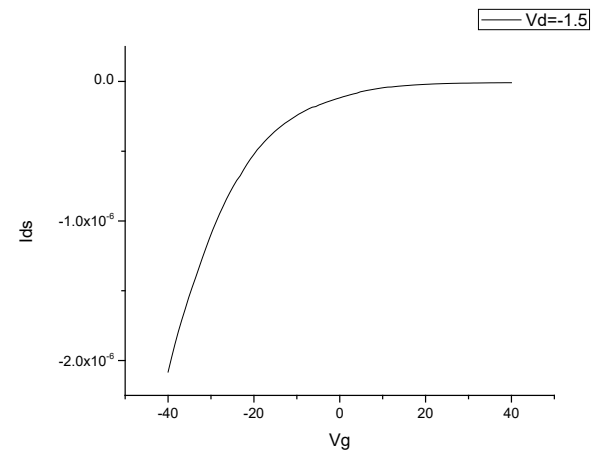




Electrical contacts were designed and written using electron beam lithography. Ti/Au (5/20 nm) metal contacts were deposited by electron-beam evaporation and lift-off. The two deposited contacts form the source and drain while the silicon substrate is used as the gate electrode. Finally, the SiO₂ insulative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

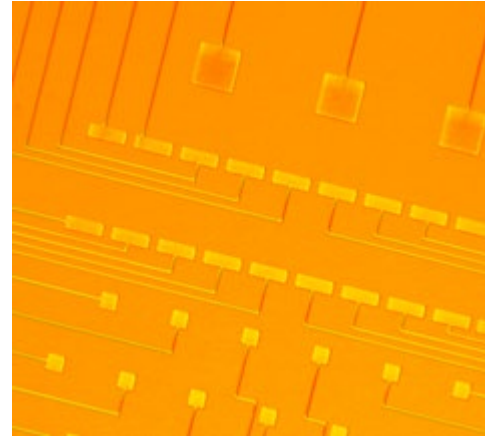
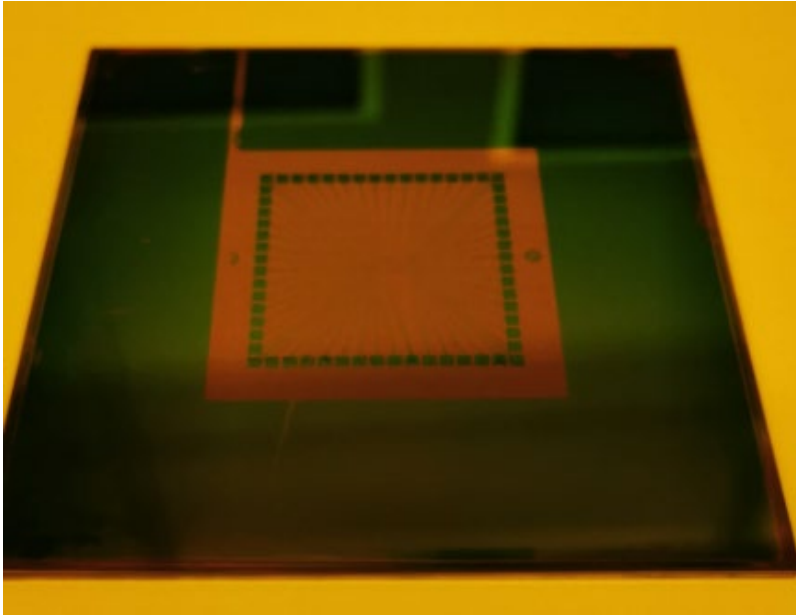


2H-C24
3-2
+M4



Electrical properties were 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

Introduction

- What is cleanroom?
- Why cleanroom is needed?
- What are the things being controlled in a cleanroom and Why?
- What are the processes done in cleanroom (MRF booklet)?

Protocols for the MEMS lab inside cleanroom

- Garments
- Follow TA's instruction

Dr. Kaul MEMS class



Dr. Kaul MEMS class



Dr. Kaul MEMS class

