

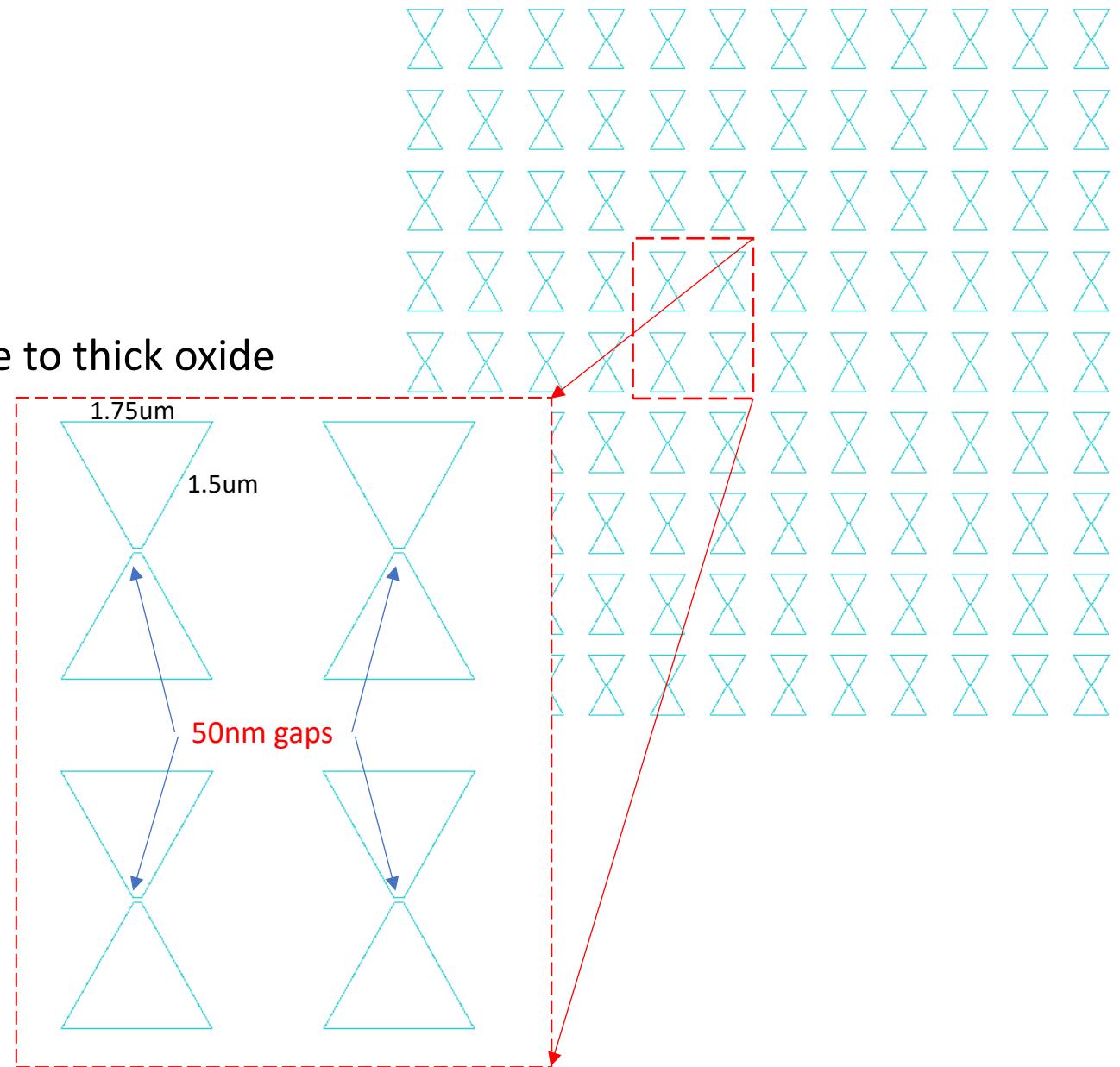
EBL 950/495 PMMA Bilayer Process for Nano-dipole Antenna

Kevin Nordquist

February 2, 2024

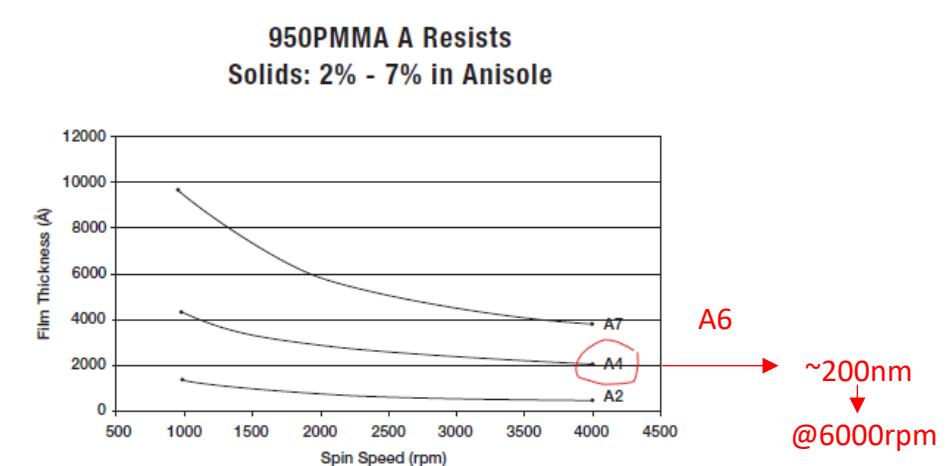
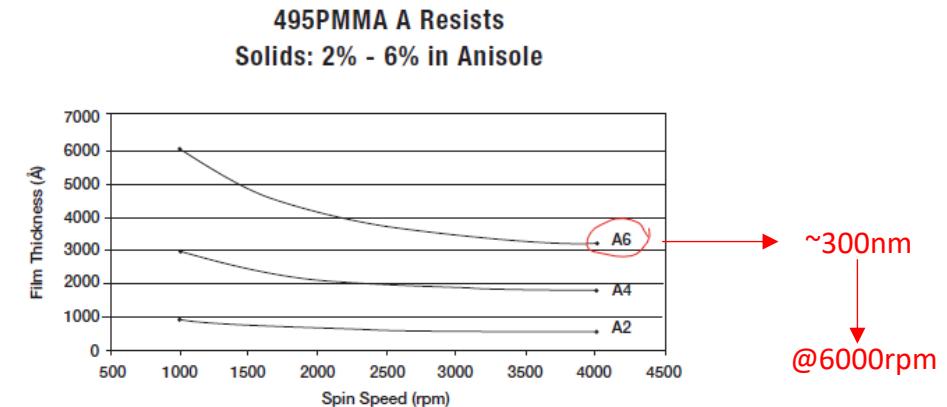
Test Wafer

- 100mm Starting Test Wafer
 - Si with $1\mu\text{m}$ thermal SiO_2
 - Charge dissipation layer required due to thick oxide
- Pattern
 - Dipole antenna with 50nm gap



950/495 PMMA Bilayer Process

- Coat
 - PMMA 495-A6
 - 6000rpm/30s
 - Bake 180°C/10m
 - $F_t=300\text{nm}$
 - PMMA 950-A4
 - 6000rpm/30s
 - Bake 180°C/10m
 - $F_t=200\text{nm}$
 - DisCharge H2O Charge Dissipation layer
 - 1000rpm/30s
 - Air dry
 - $F_t=5\text{nm}$



Exposure Dose Series

- Elionix 100keV BODEN
 - Expose antenna array
 - Dose range 1200 to 3000 μ C/cm²
 - 100 x 100 μ m field
 - 1nA Beam I
 - 2.5nm Beam diameter
- Develop
 - Remove DisCharge film
 - Immerse in H₂O for 60s to
 - Blow dry N₂
 - Develop PMMA bilayer
 - Immerse in 1:3 MIBK:IPA, 45s (12°C)
 - Rinse in IPA 10s
 - Blow dry N₂

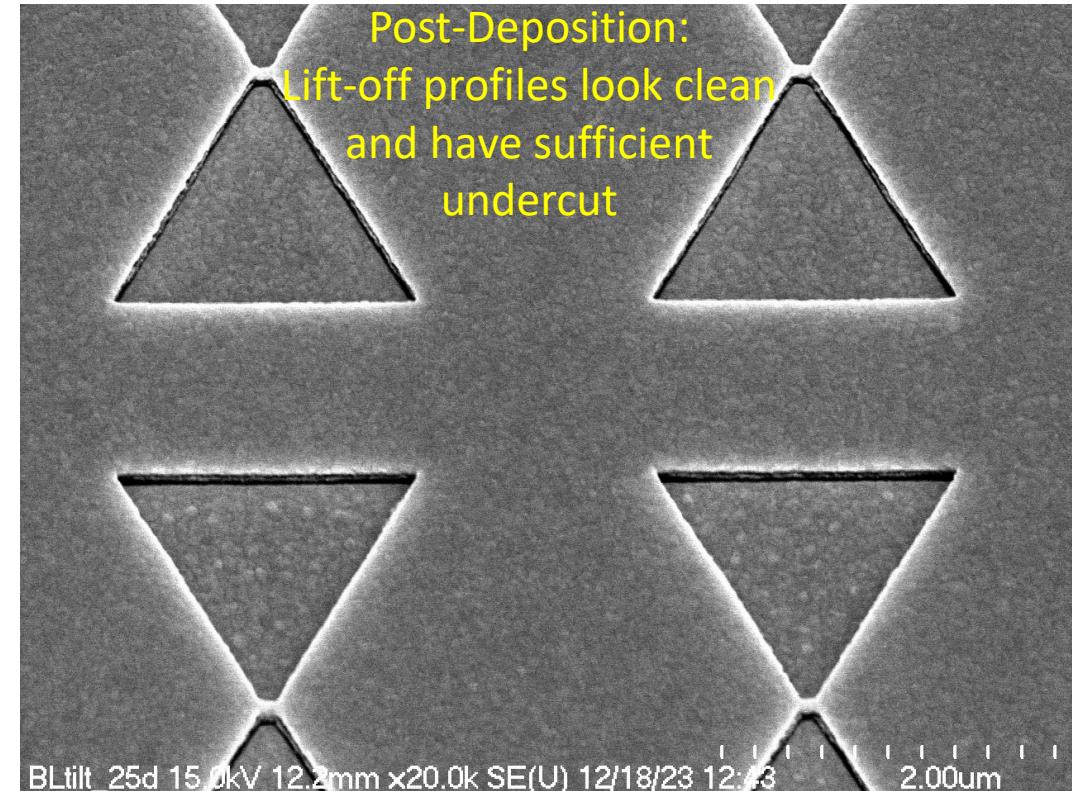
Cr/Au Deposition & Lift-off

- Lesker #3 Evaporation Deposition System

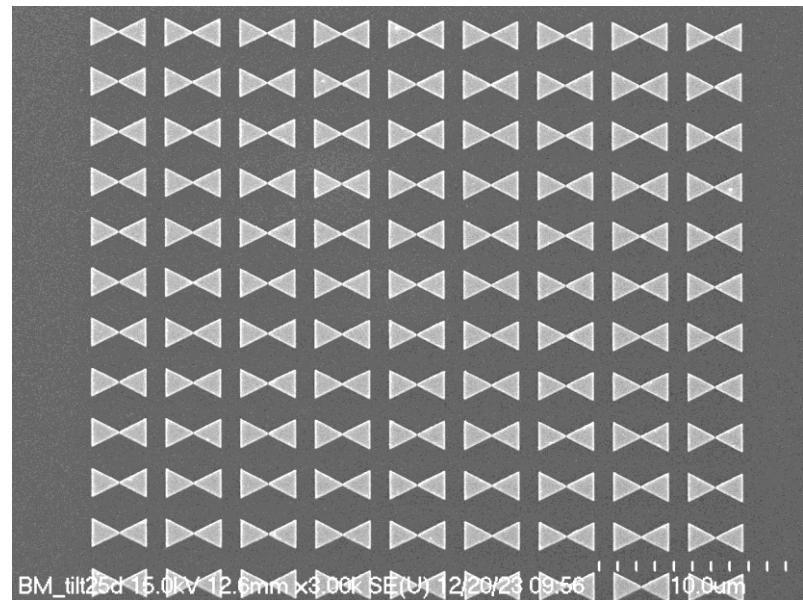
- 5nm Cr
- 100nm Au

- Lift-off process

- Kayaku Remover PG (NMP)
 - Two baths, each @ 70°C
 - H₂O rinse
 - Blow dry N₂

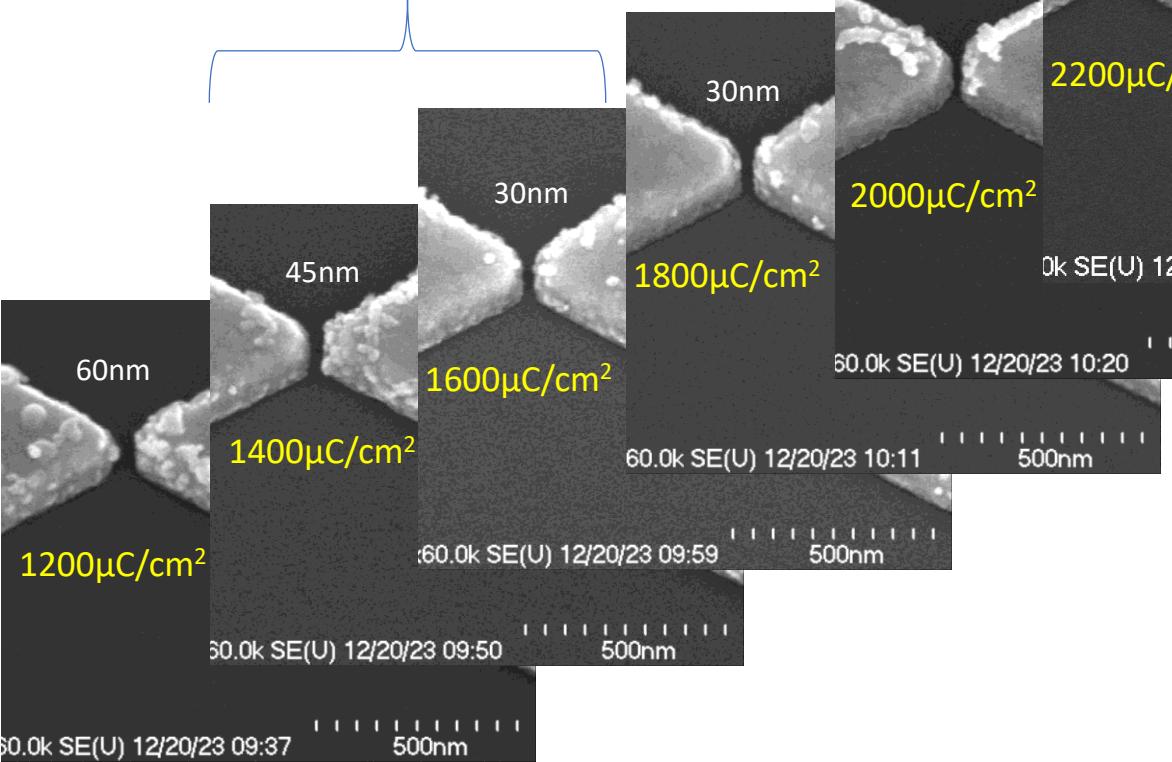


Post-Lift-off



1600 μ C/cm²

1500 μ C/cm² selected



25nm

2200 μ C/cm²

$\approx 2200 \mu\text{e}/\text{cm}$

60.0k SE(U) 12/20/2

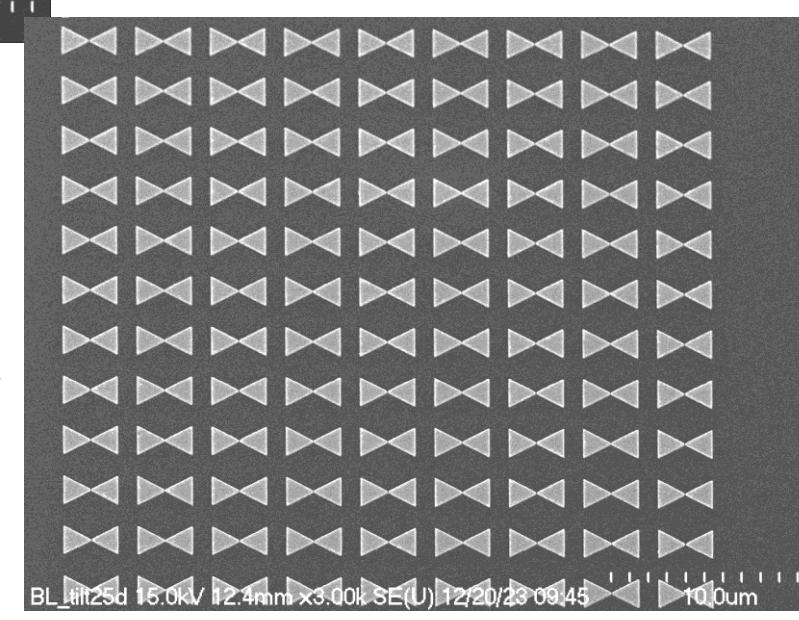
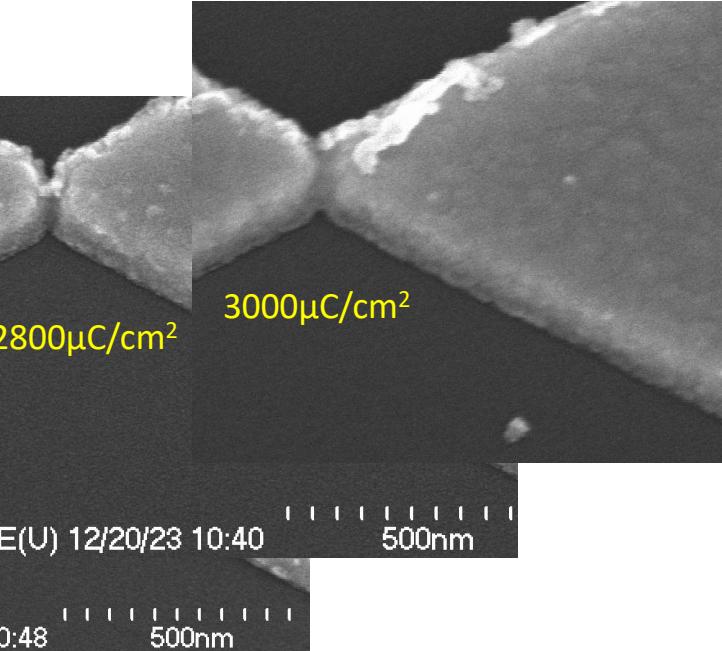
0k SE(U) 12/20/23 11:10

2019-09-29 500nm

1990-91: The first year of the new system.

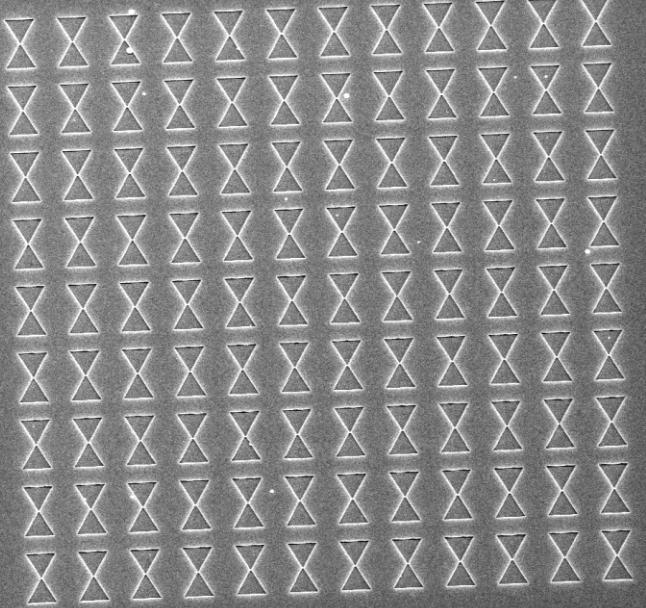
Unm

$1400\mu\text{C}/\text{cm}^2$



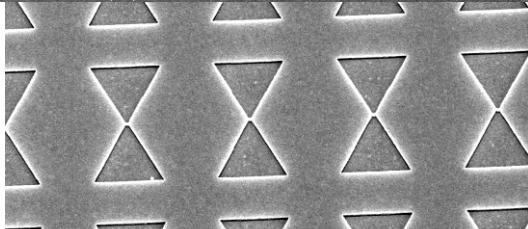
Pre-liftoff SEM Inspection ($1500\mu\text{C}/\text{cm}^2$)

Location 1



15deg 15.0kV 11.3mm x2.50k SE(U) 1/25/24 10:45

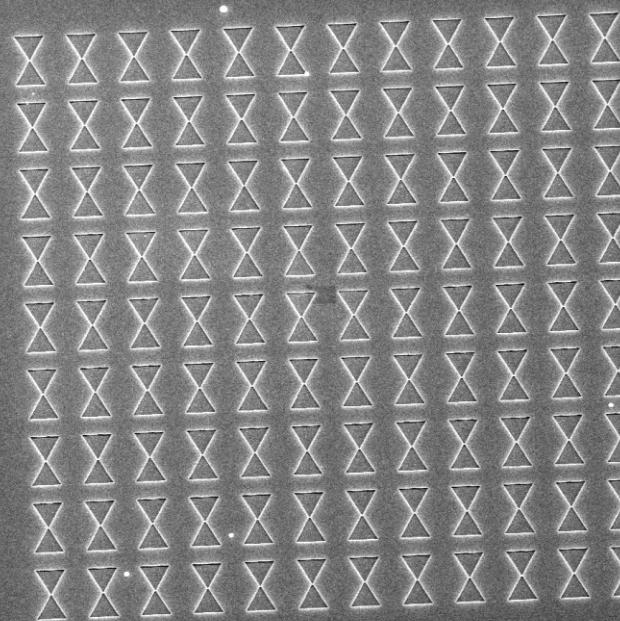
20.0u 15deg 15.0kV 11.4mm x2.50k SE(U) 1/25/24 10:57



11.3mm x 10.0k SE(U) 1/25/24 10:46 5.00μm

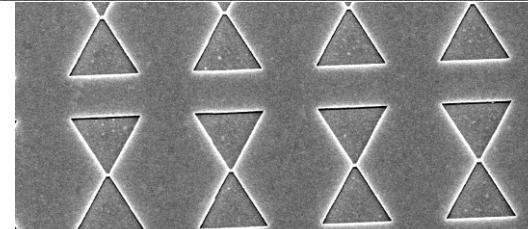
5deg 15.0kV 11.4nm x70.0k SE(U) 1/25/24 11:11 500nm

Location 2



20. 15deg 15.0kV 11.5mm x2.50k SE(U) 1/25/24 11:16

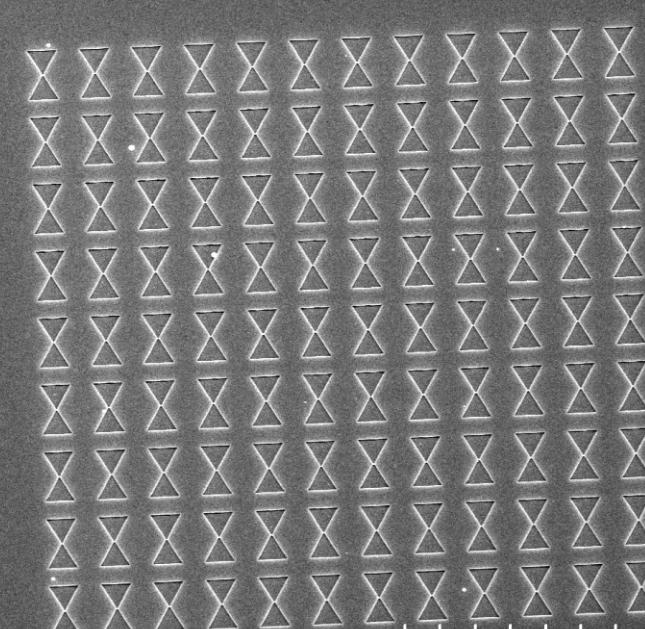
20.0um



5.0kV 11.4mm x10.6k SE(U) 1/25/24 11:10 5.00

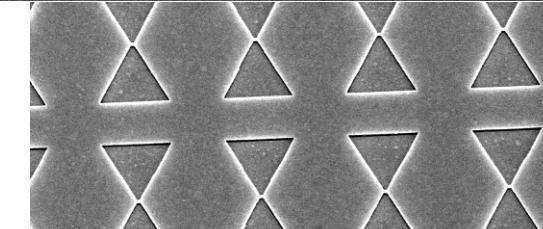
15deg 15.0kV 11.5μm x70.1k SE(U) 1/25/24 11:18 500nm

Location 3



1/25/24 11:16

20.0um



11.5mm x10.0k SE(U) 25/24 11:17

15deg 15.0kV 11.5μm x70.1k SE(U) 1/25/24 11:18 500nm