

Research and Educational Opportunities at UNM's MTTC Cleanroom

SOE Lab Tour 2026

Enabling Microsystems and Nano Fabrication

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University of New Mexico

Manufacturing Engineering Program

MTTC Cleanroom

Outline

- What is the MTTC?
- Equipment available for research and development
- Classes and Projects
- The Manufacturing Engineering Program

Manufacturing Training and Technology Center





Our Team

- Matthias Pleil, Ph.D. – Physics – Director/Manager MEP/MTTC
- Nathan Jackson, Ph.D.- Bio Eng. – Assoc. Dir. MEP/MTTC, Dir. NSME
- Bernardo Martinez-Tovar, Ph.D. ECE - Research Engineer

Technical Staff

- Mark Hofheins – Senior Tech
- Richard Marchant – Senior Tech
- Junifer Nez – Graphics/Web/VR/Video

Administrative

- DiAnn Archuleta – Financial/Admin

MTTC/MEP – Established in the mid-90's

- Dr. John Wood's Legacy

- State RPSP funded for 30+ years! ~\$570k/yr
- Cleanroom Access for:
 - Industry Startups
 - Educational Opportunities
 - Research and Development
- Classroom
- Auditorium
- >\$250M in startup/research grants enabled work

Cleanroom Capabilities

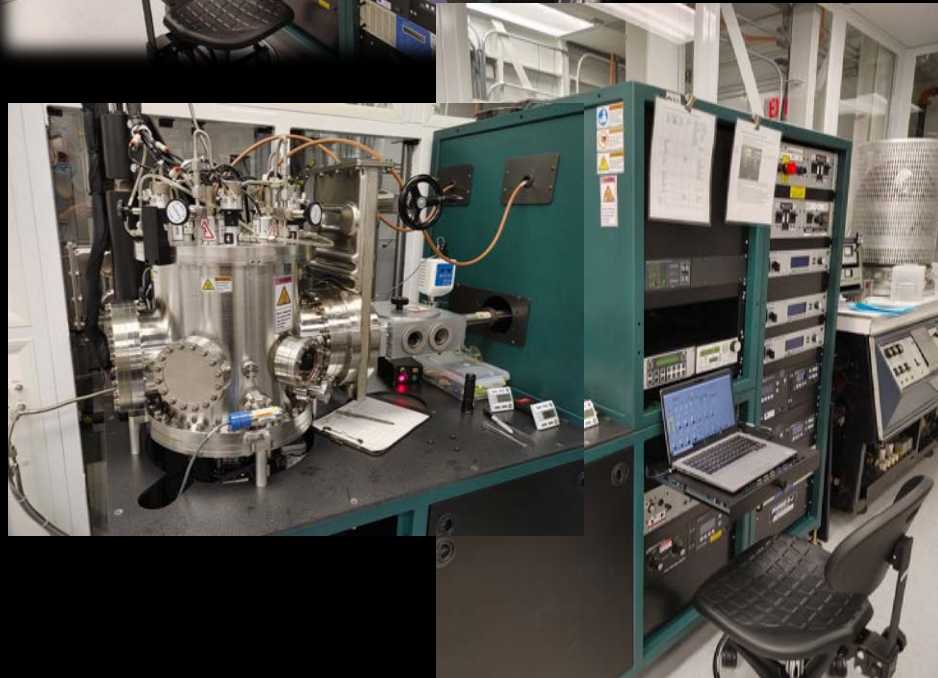
- Process
 - Photolithography
 - Contact printing with backside alignment
 - Maskless printer
 - Coaters, HMDS, Bake Plates
 - Etching
 - Wet Isotropic and Anisotropic Wet Etching
 - Dry anisotropic etching (RIE/DRIE)
 - Vapor Etch (HF, XeF₂)
 - Ion Mill
 - Deposition
 - Oxide Growth
 - Sputter Deposition
 - Oxides, dielectrics
 - Metal/Alloys
 - Evaporative
 - Paralyne

Cleanroom Capabilities

- Metrology
 - Several Optical microscopes/cameras
 - SEM
 - Standard SEM
 - EDS – Electron Dispersive Spectrology
 - Surface Roughness
 - Surface Profile
 - DekTak XT – Step height & surface roughness
 - Thin film
 - Oxide/photoresist thickness- Nanospec
 - Filmetrics – Planned
 - 4pt probe (surface resistivity)
 - Probe
 - Multi probe, waveform generator, oscilloscope, dvm, power supply
 - Interferometer

Equipment

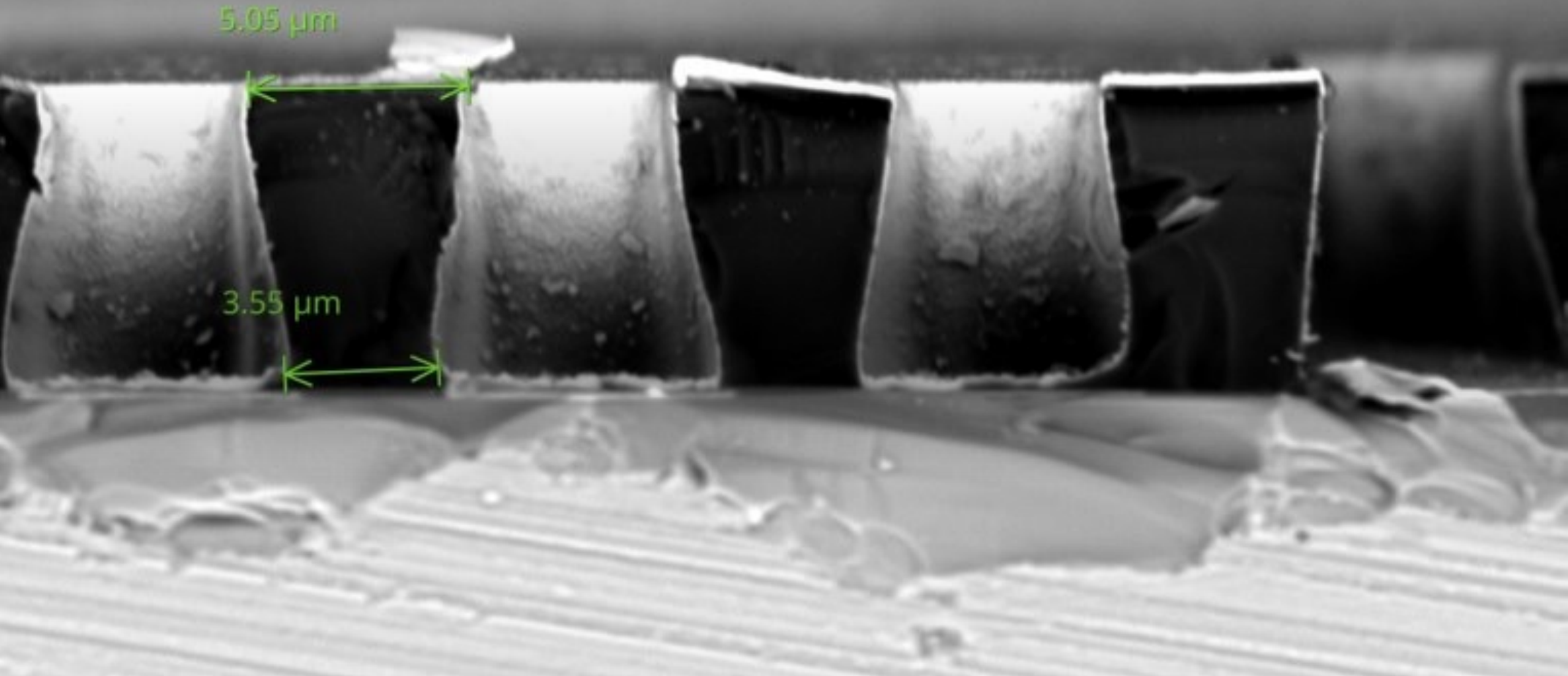
Sputter - AJA



DC (Metals)
Pulsed DC
RF (oxides/dielectrics)

Si3N4	Silicon Nitride
AlN	Aluminum Nitride
Al2O3	Aluminum Oxide
SiO2	Silicon Dioxide
Si	Silicon
In2O3/SnO2	Indium sesquioxide/ tin dioxide
Ta2O5	Tantalum Oxide
Si P-type	Silicon
SiC	Silicon carbide
PZT	Lead Zirconate Titanate
Cu	Copper
W	Tungsten
Ti	Titanium
TiW	Titanium/ Tungsten
Au	Gold
Sn	Tin
Al	Aluminum
Ni/Cr	Nickle/Chrome
Ag	Silver
Ni	Nickle
Cr	Chrome
Pt	Platinum
Fe	Iron
Ta	Tantalum

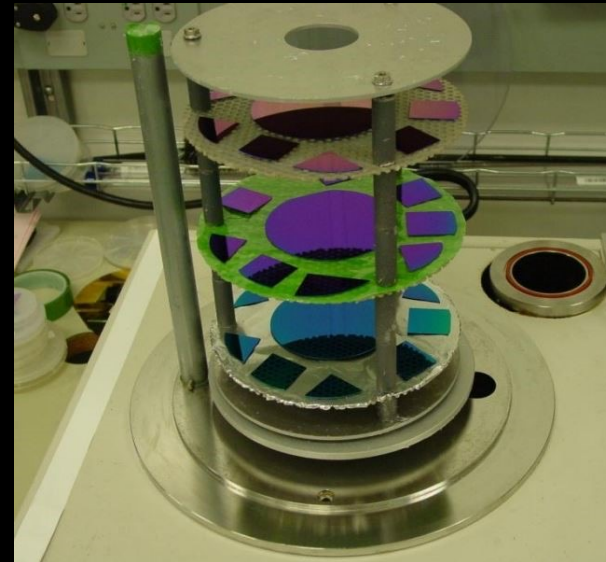
Metal on Photoresist



Paralyne Coater

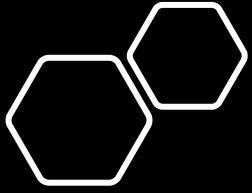


- Biocompatibility
- Truly conformal material (pin-hole free at 25 nm thickness)
- Thin film dielectric
- Excellent moisture/chemical barrier properties
- High mechanical strength.





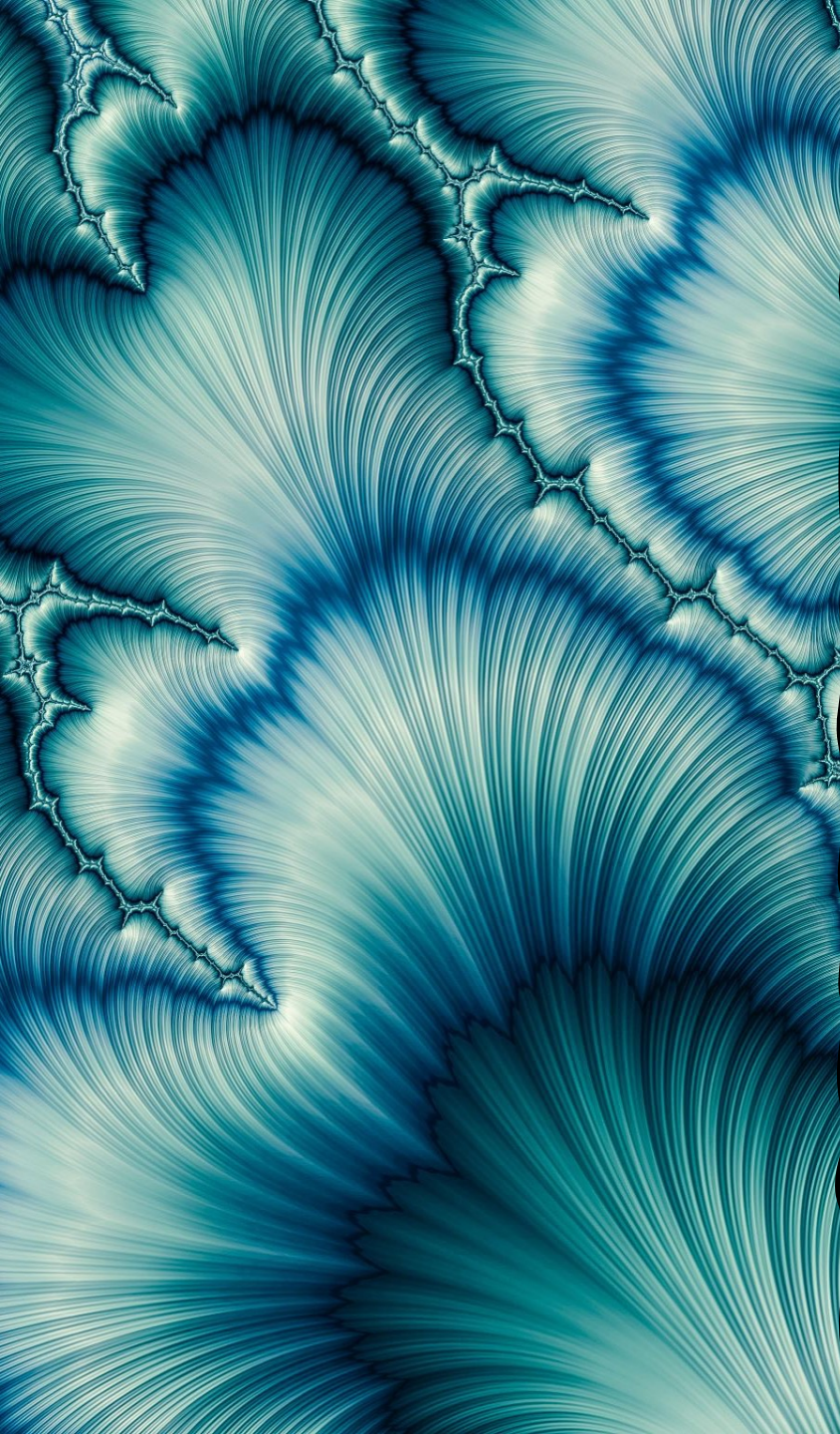
Furnace



Oxide, Anneal and Diffusion

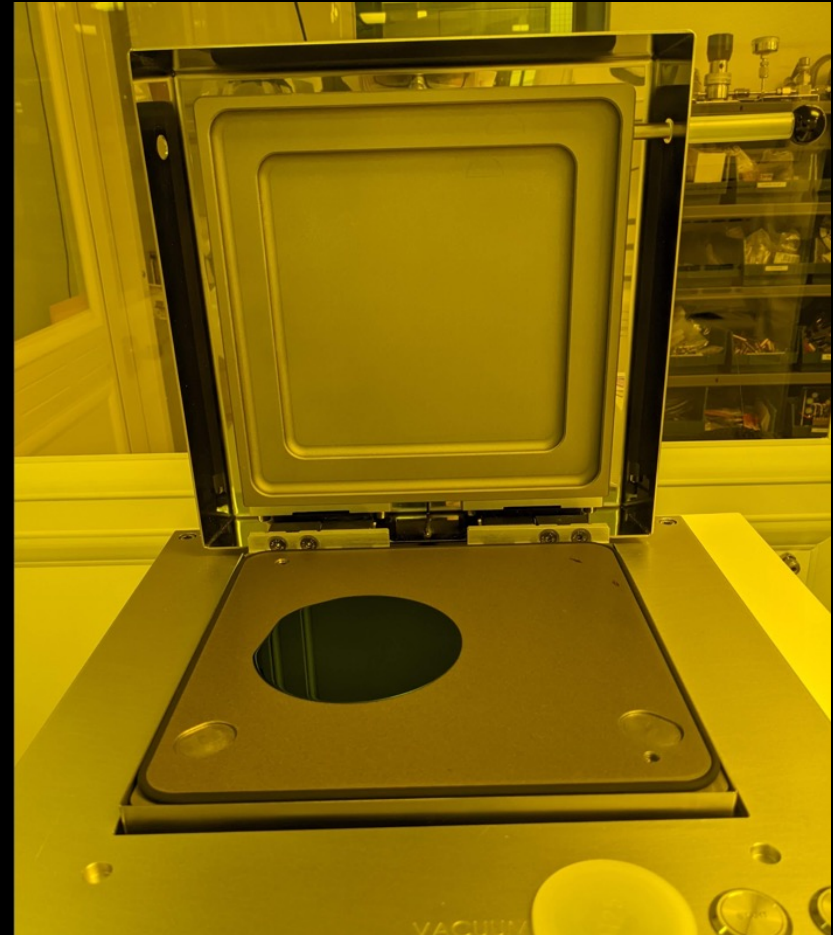
- Furnace
- Wet and Dry Oxidation
- Silicon Oxide up to 20kA
- Solid source doping





Lithography

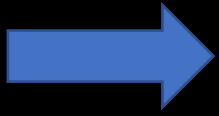
Vapor Prime - HMDS



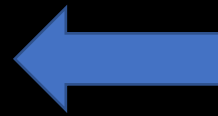


Coat

Expose



Develop



Spin Rinse Dry

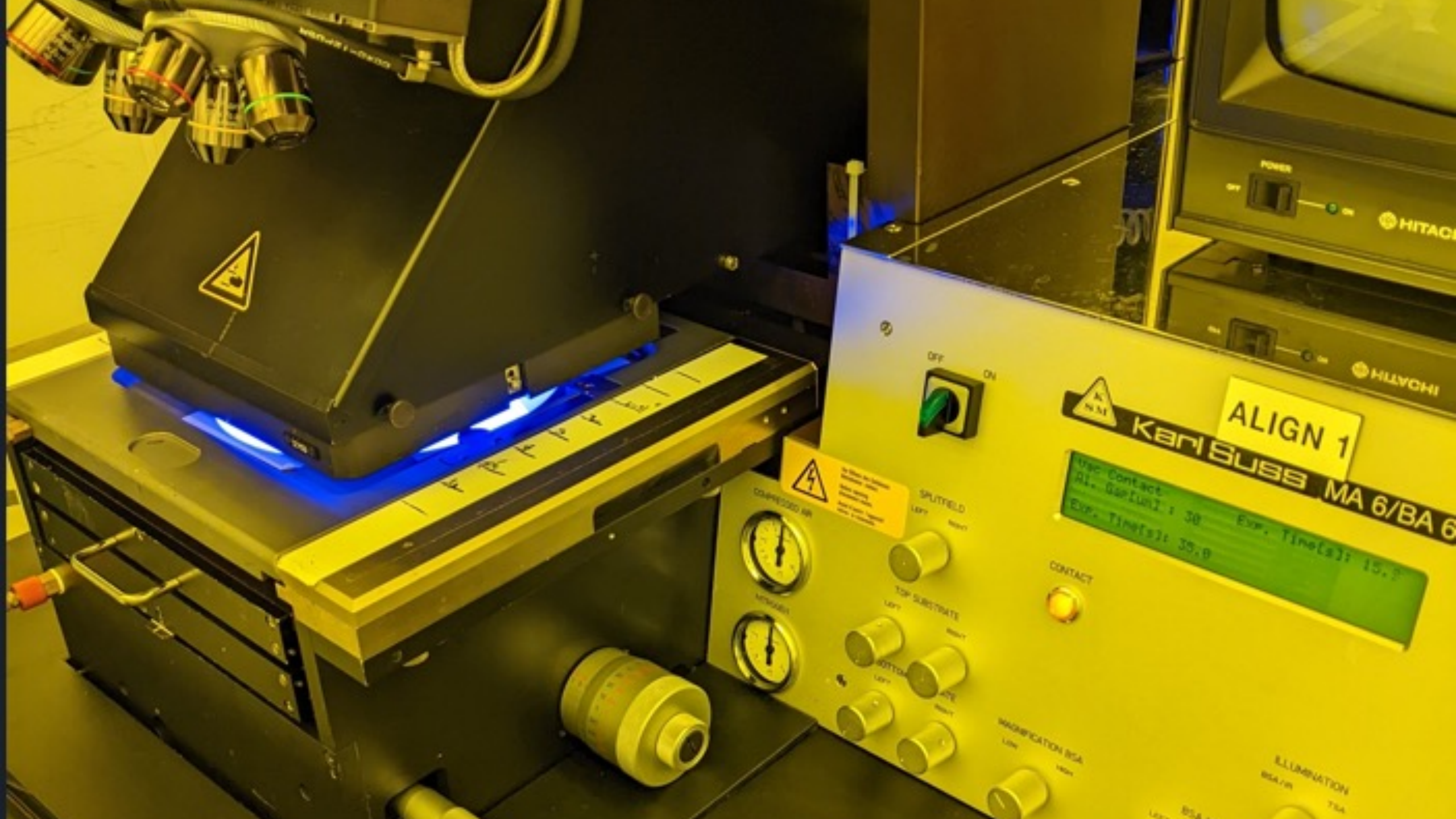
Coat Process – Bay 1

Bay 4 Coater



Karl Suss MA/BA 6





ALIGN 1

KARI SUBB MA 6/BA 6

Up Contact
Al. Gap [um]: 30
Exp. Time[s]: 35.8

OFF ON

⚡
Do not touch the High Voltage
parts, especially the
anode, when the power is
on. High voltage is applied
even when the power is
off.

COMPRESSED AIR
LEFT RIGHT

SPUTTERFIELD
LEFT RIGHT

TOP SUBSTRATE
LEFT RIGHT

BOTTOM SUBSTRATE
LEFT RIGHT

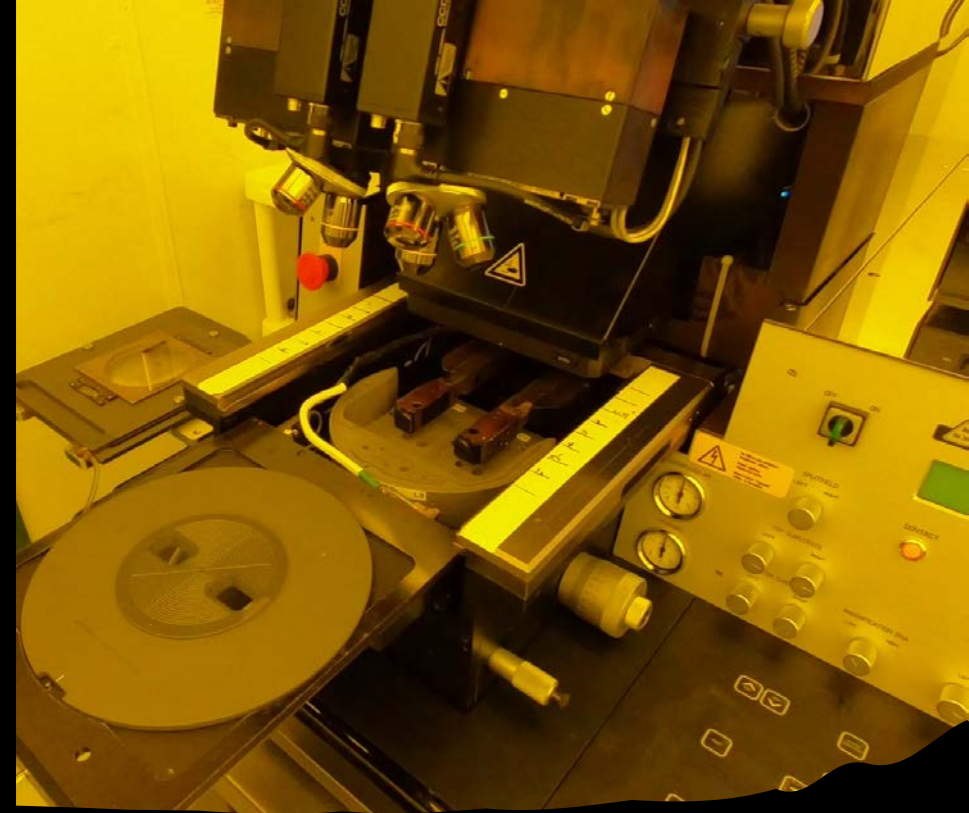
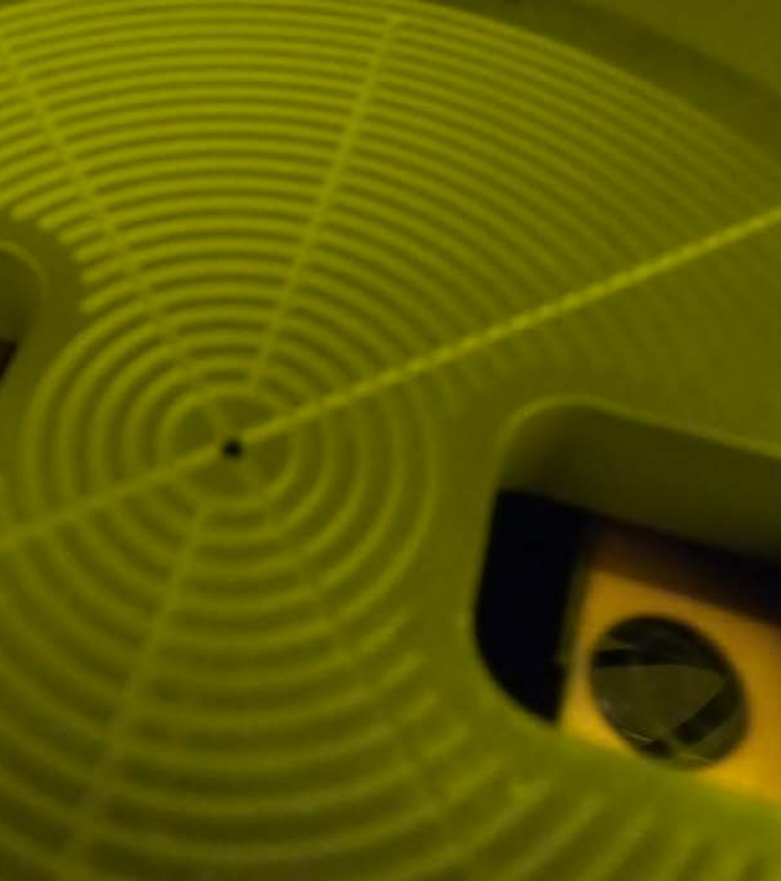
MAGNIFICATION BSA
LEFT RIGHT

ILLUMINATION
BSA/IN T54

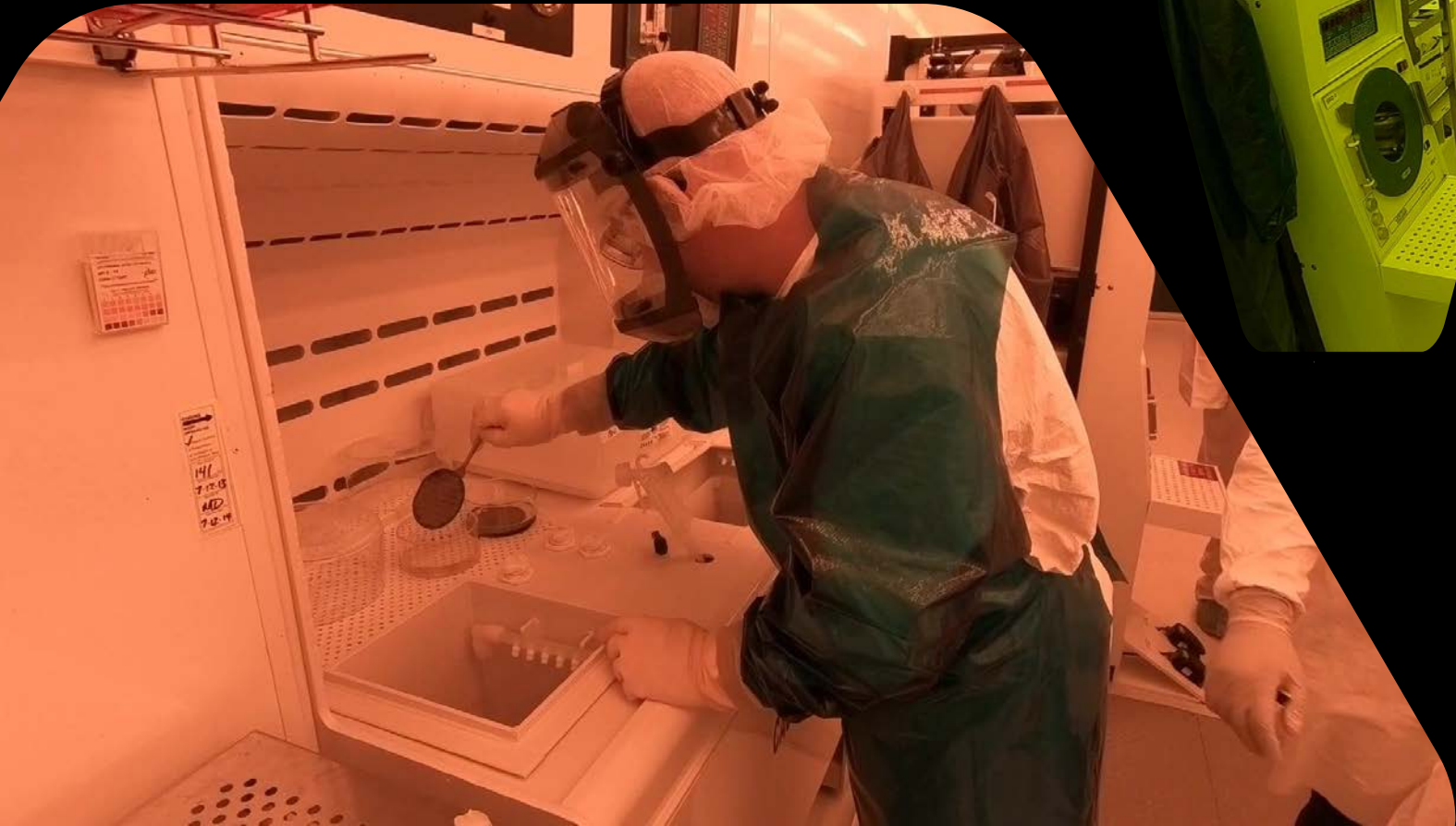
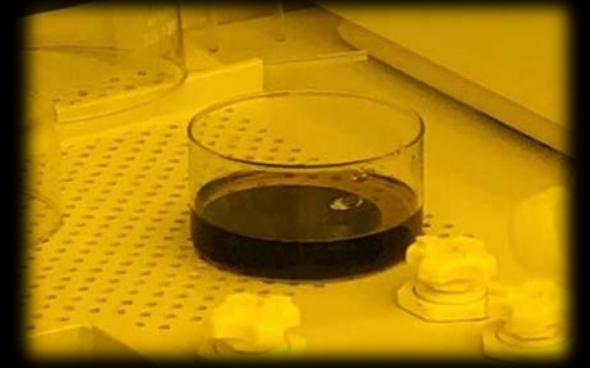
POWER

HITACHI

HITACHI

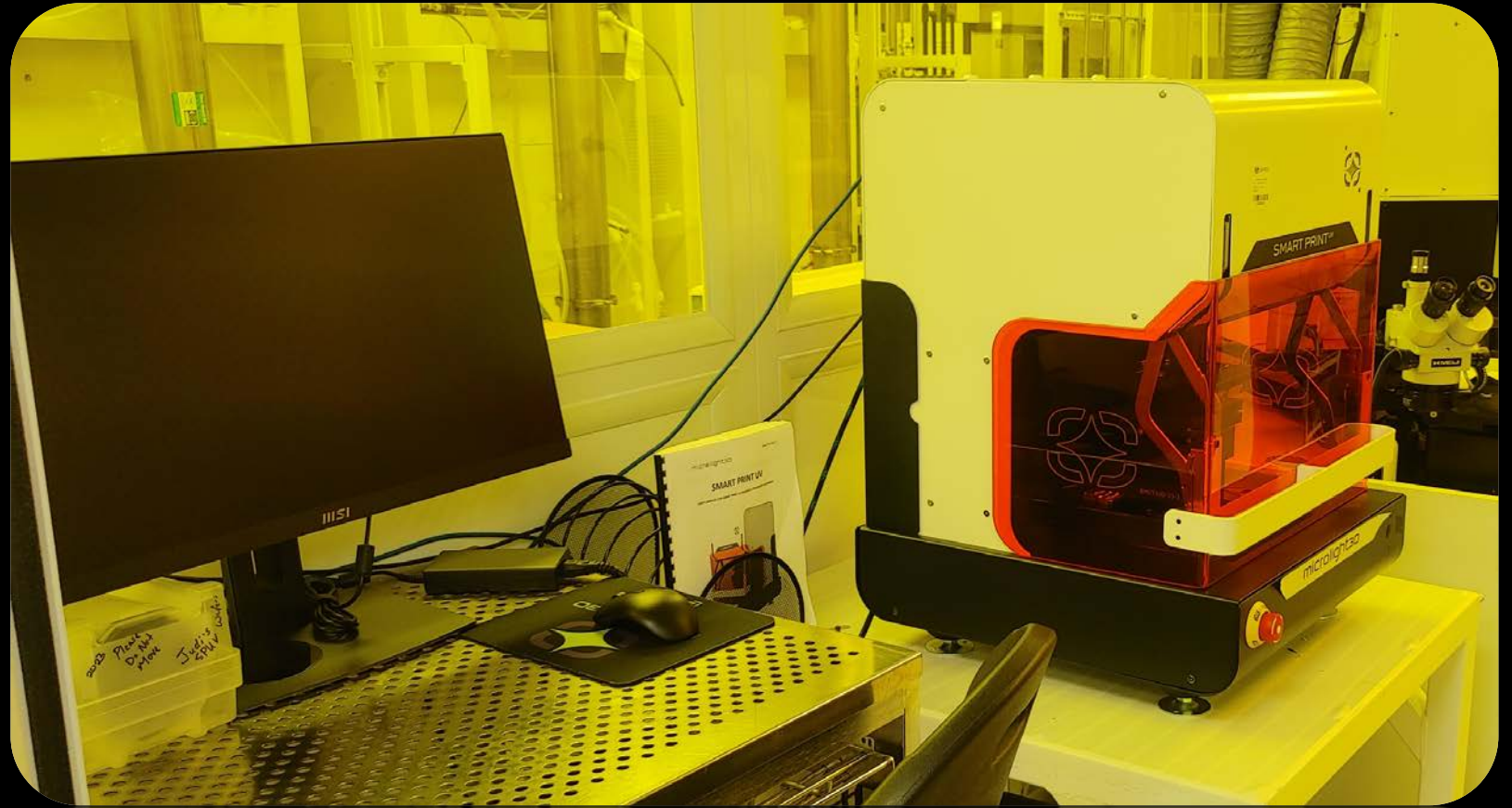


Backside Alignment Microscopes



Develop and
Wet Etch
BOE, KOH...

Newest Litho Tool



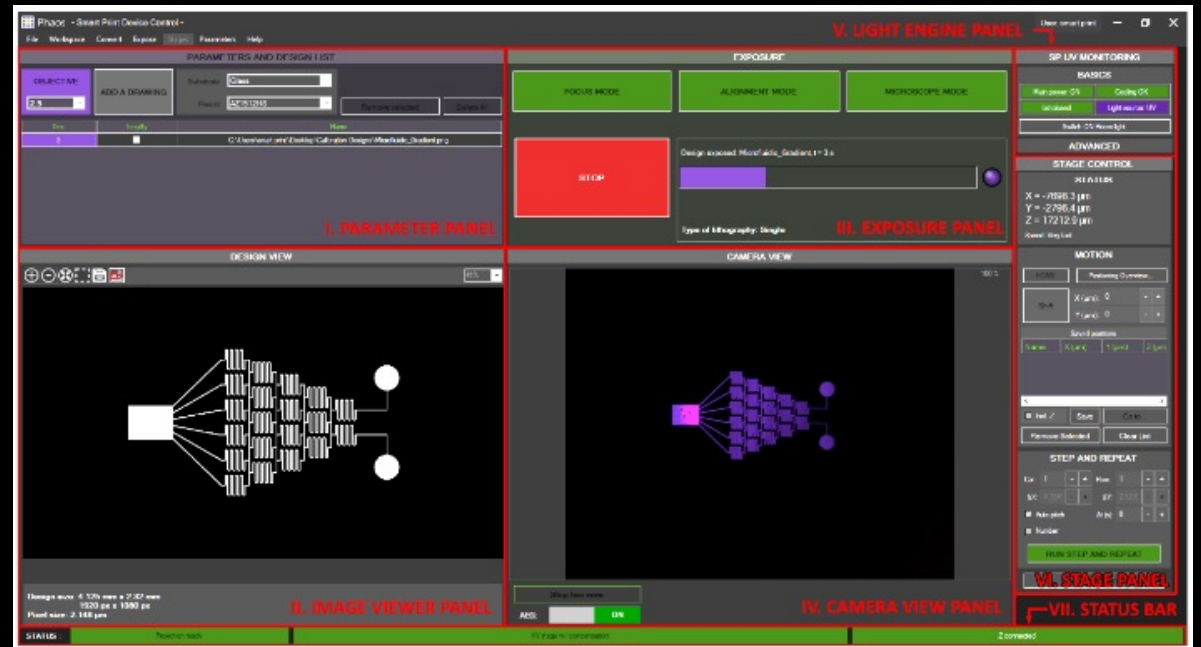
6/30/2022

4:43:18.191 PM

1X @2.5S

Pitch
Measurements

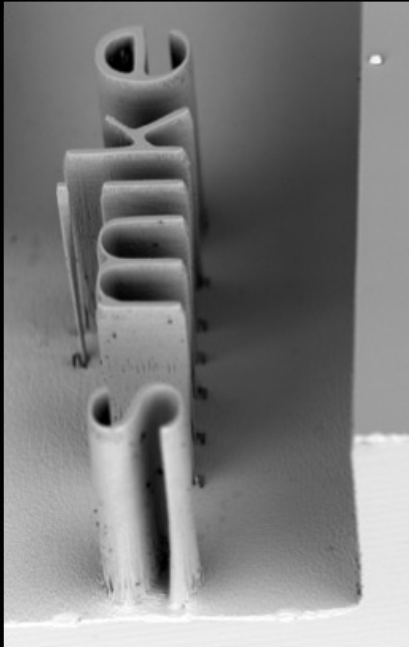
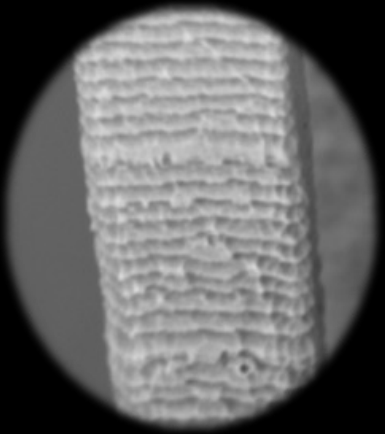
Line
Measurements



Maskless Printer! Direct from design to wafer



Etch



Deep Reactive Ion Etching
Bosch Process



Alcatel Deep Reactive Ion Etcher

Glow Research RIE (Reactive Ion Etcher)



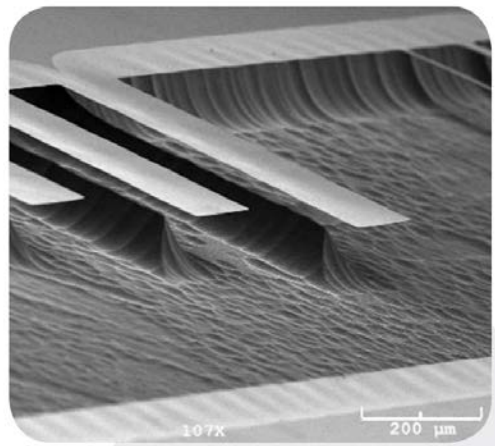


Fig 5 Cantilevers undercut using XeF_2 release etch

FIG 2 Cantilevers undercut using XeF_2

SPTS XeF_2
Si, Mo, Ga
Isotropic etch



Vapor Etch (Release)



Idonus HF Vapor Etch

Release - Critical Point Dryer



METROLOGY

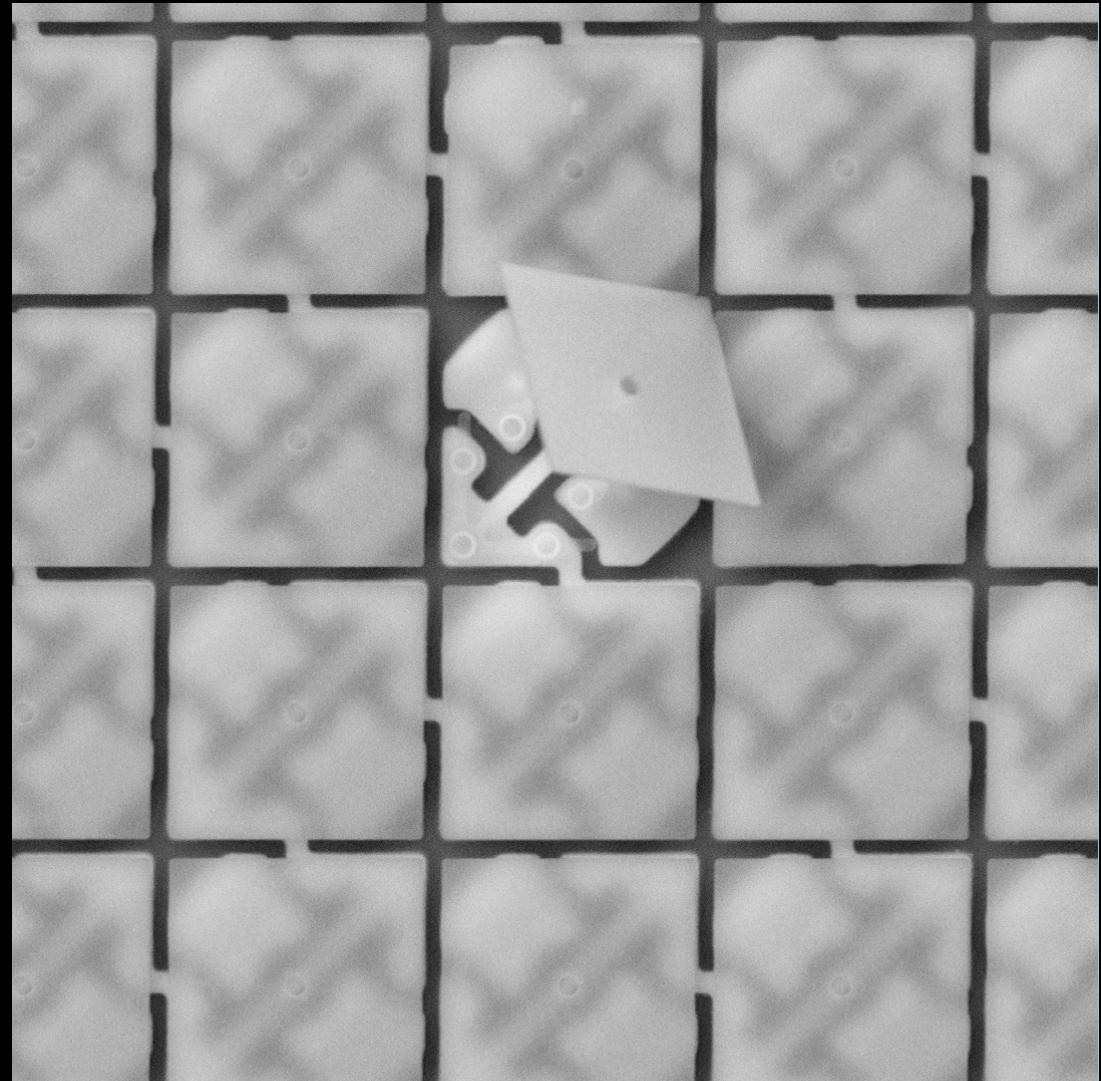
OPTICAL MICROSCOPES

SEM

THIN FILM MEASUREMENT

PROFILOMETER

PROBE STATION



10 μ m

8700x

15kV -Image

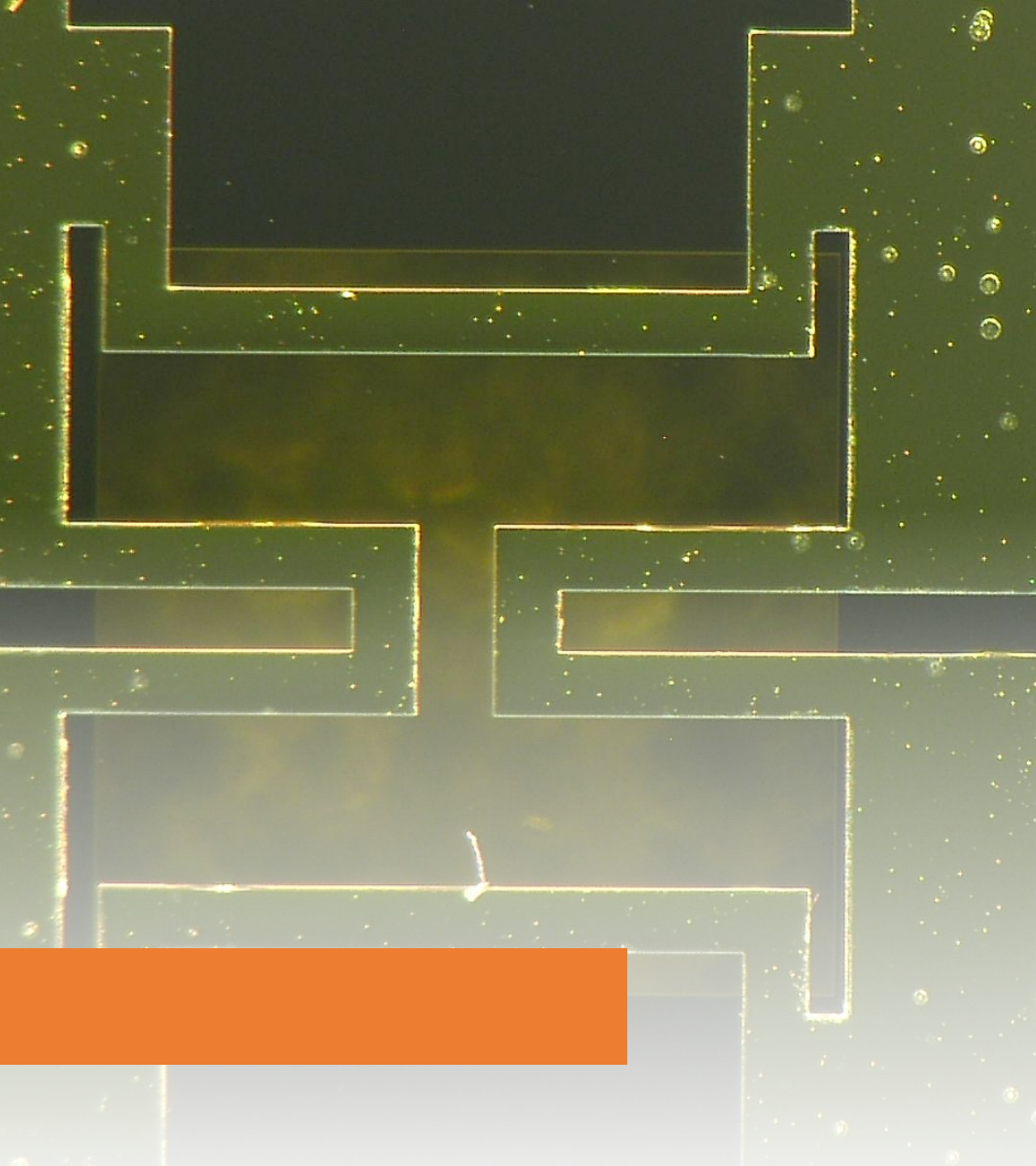
View PDF controls

BSD Segment A

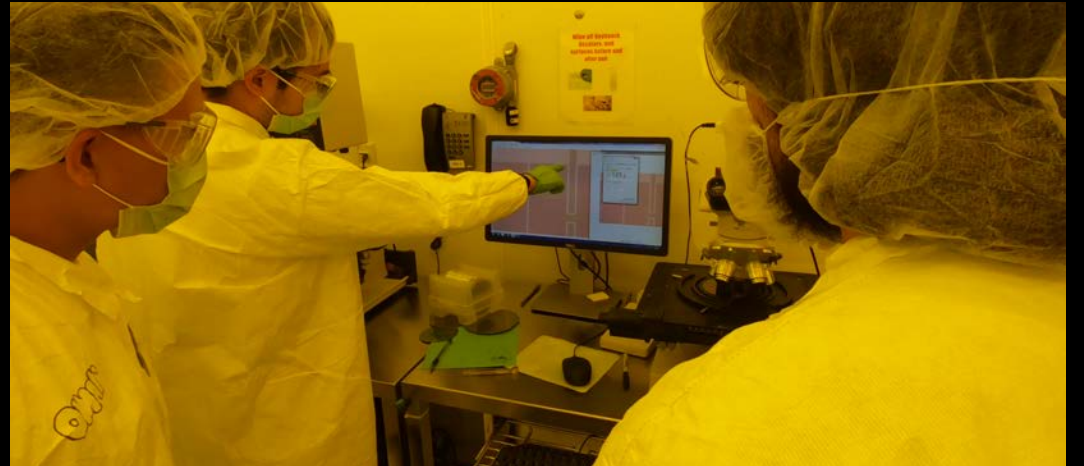
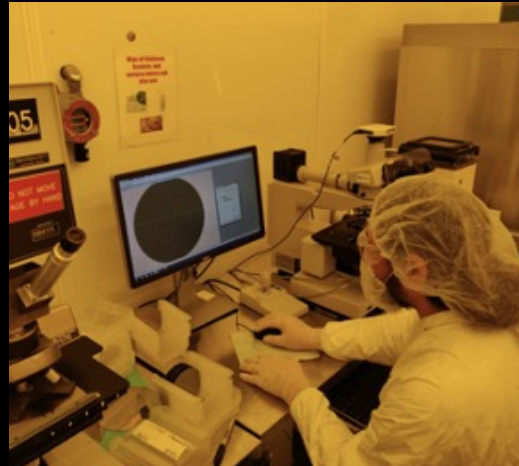
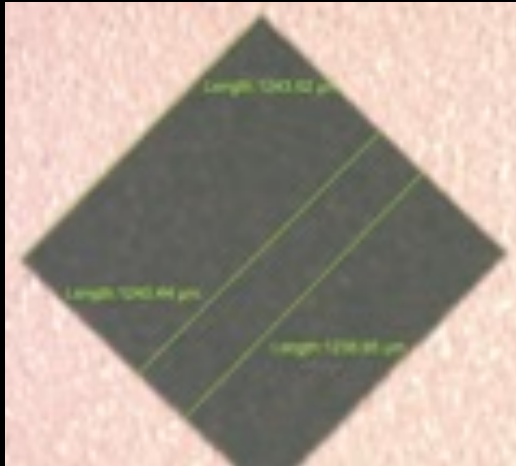
4_45m

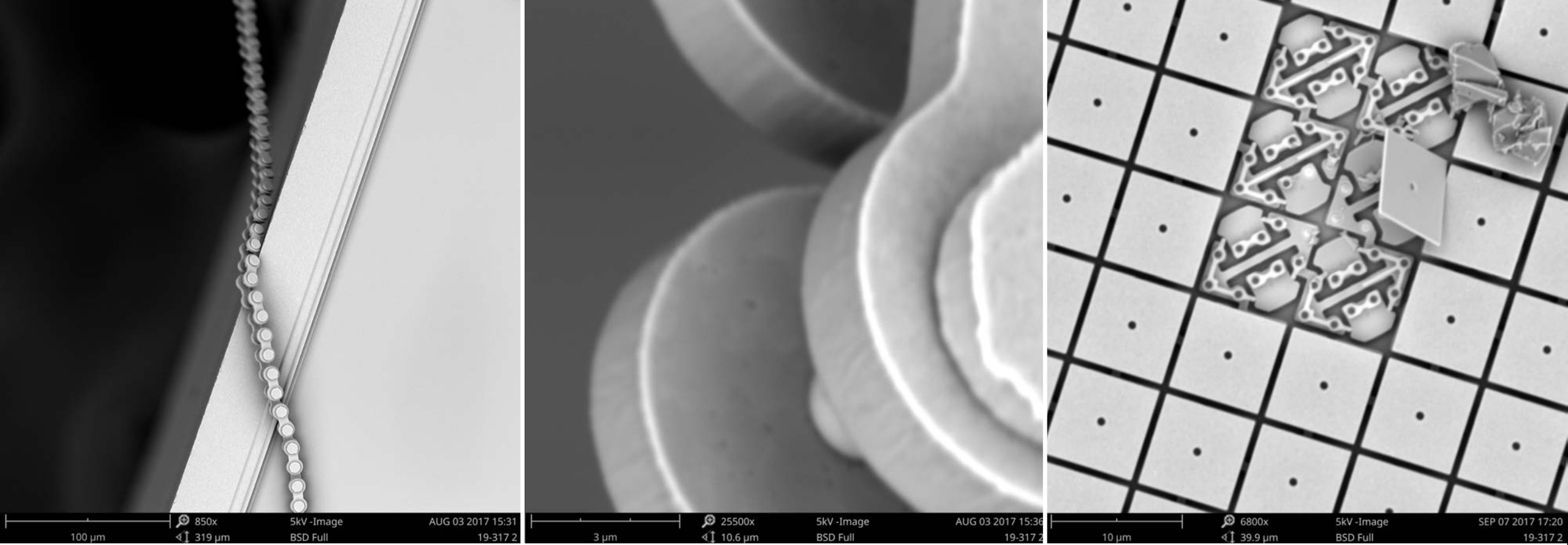


Inspect



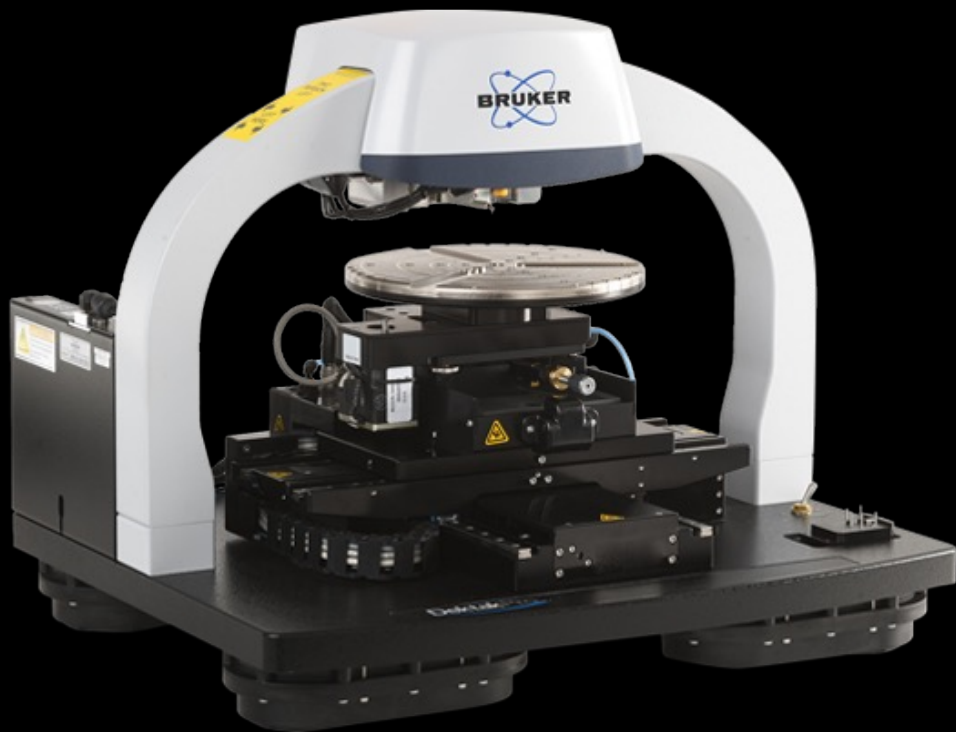
Microscope Inspection



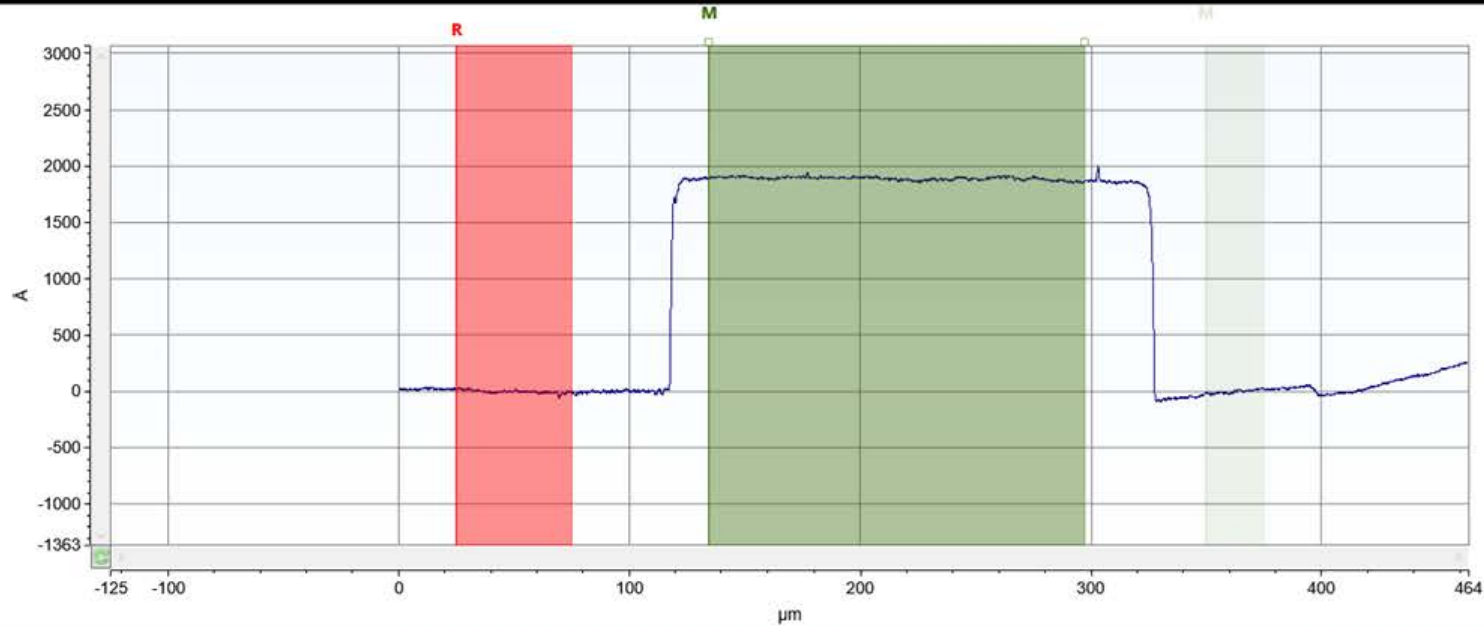


SEM w/ EDS, Surface Roughness

Profilometer Inspection - DekTak



DekTak – Profiles



Analytical Results

Label	Value	R Pos	R Width	M Pos	M Width	ID
Total_ASH	0 Å	1.106 mm	-0.42 mm	1.768 mm	-83.293 µm	Segment 1

Meta Data

Label	Value
Date	4/22/2024
Profile	HillsAndValleys
ScanDuration	50 s
ScanLength	500 µm
ScanResolution	0.0333289 µm
ScanType	Standard Scan
StylusForce	3 mg
StylusScanRange	6.5 µm
StylusType	Radius: 12.5 µm
Time	10:19:52 AM

- Data Leveling
- Average Step Height
- Roughness
- Step Detection
- Trace Analysis
- Database

Plot Legend

- Total Profile

Cursor Status

Label	Position (µm)	Total Profile (Å)	Width (µm)
R	25.0000	0.0000	50.0000
M	134.5726	1891.8678	162.5549
Δ	109.5726	1891.8678	

Cursor Control

Watch List

Label	Value
Total_ASH	0.19 µm



Probe Station

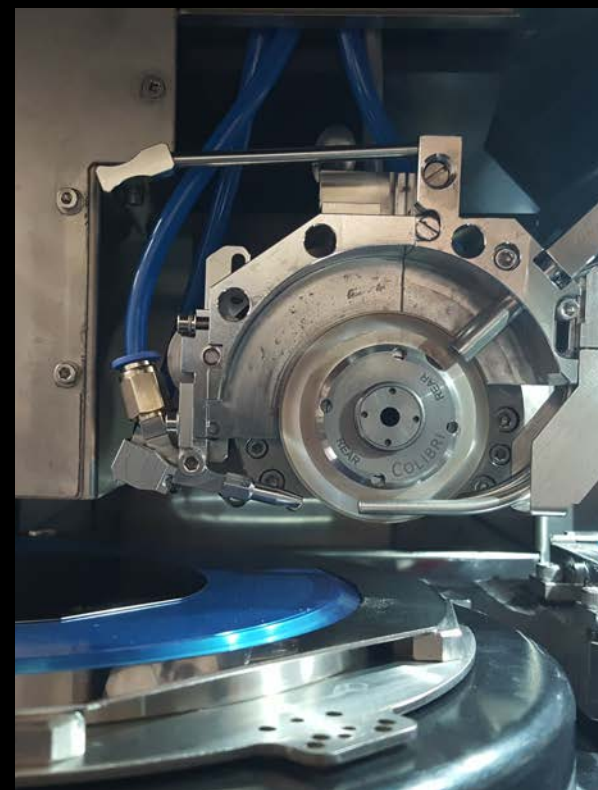
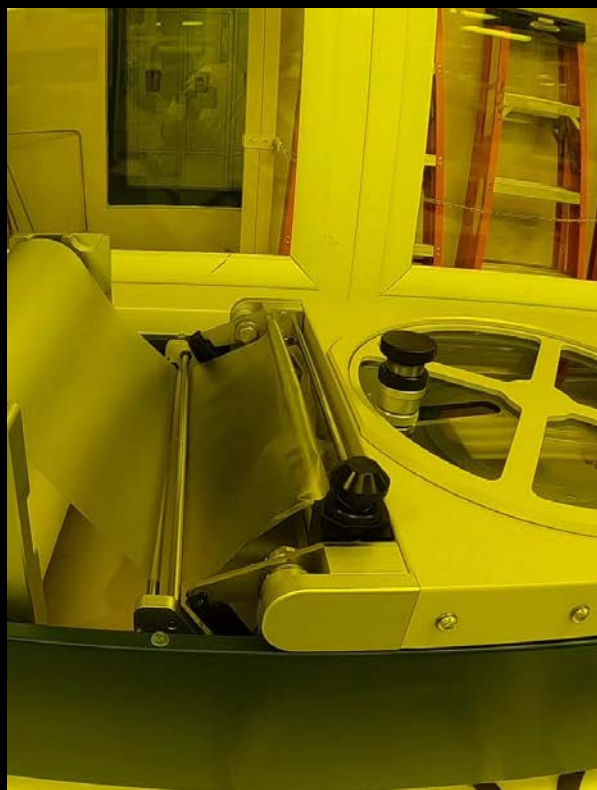
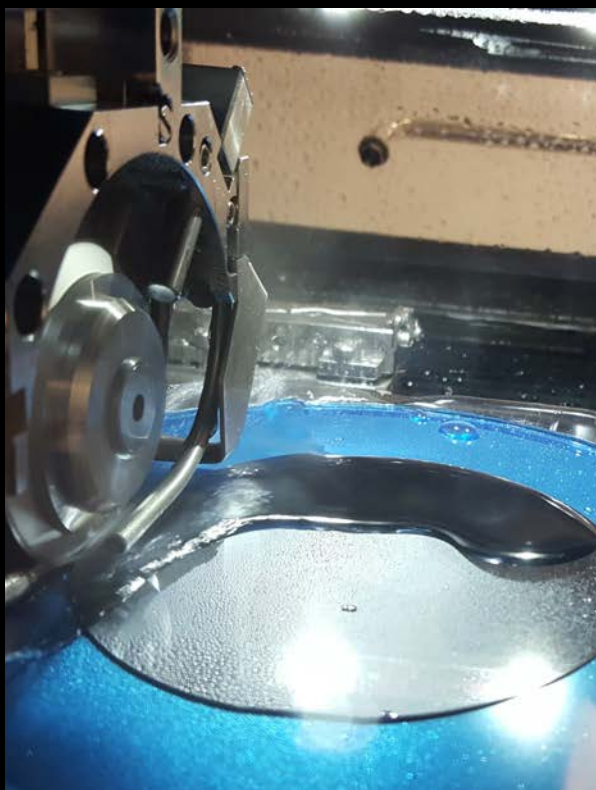
4pt Probe





Additional Tools

Dicer and Taper





Classes –

Micro Fabrication Concentration

- ME417/517 – Fundamentals of Microsystems Fabrication
- ME418/518 – Foundations of MEMS Design
- ME419/519 – Advanced Micro and Nano Fabrication

Other courses

- IGE Courses – Special Topics – NSF Funded
- Problems Courses – Projects, Honors Thesis

CNM courses

Course Example: Fundamentals of Micro Fabrication 417/517

*Get your students to take this if
they will be doing research in a fab
(CHTM, CINT, and MTTC).*





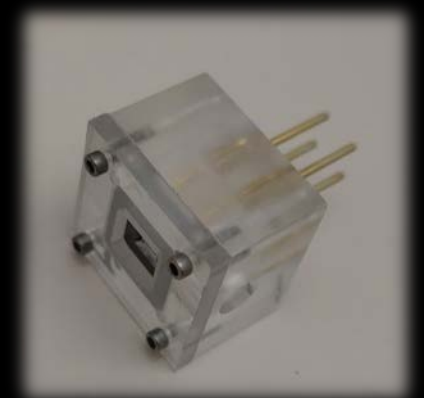
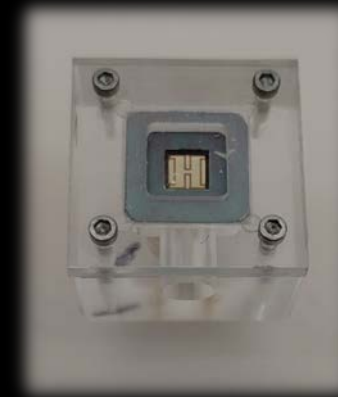
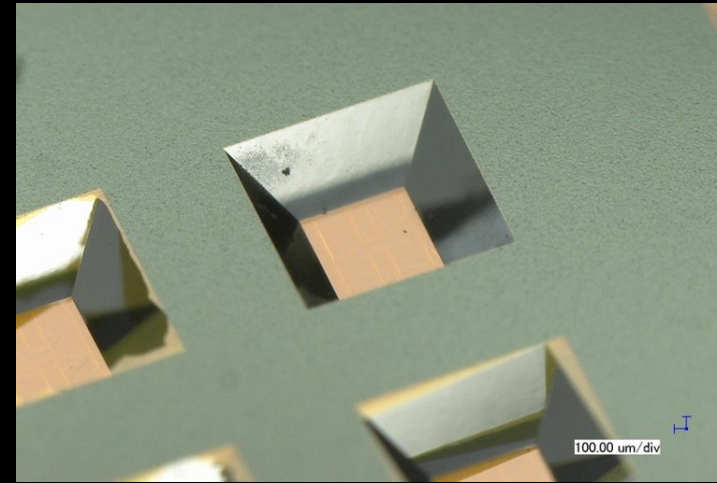
Art Wafer: Basic Photolithography
and Wet Etching hands-on
experience

First Steps – ½ day experience

- Mask
- Coat
- Expose
- Develop
- Rinse/clean
- BOE Etch (PPE)

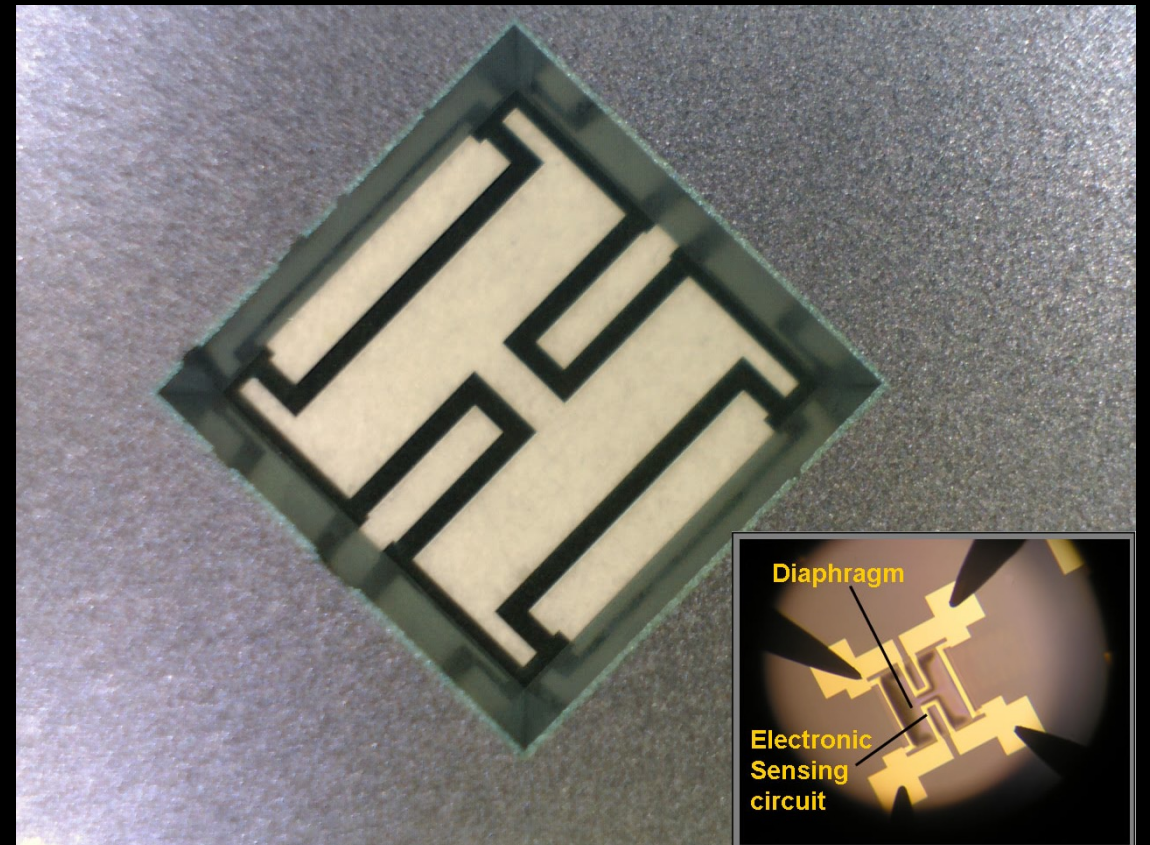


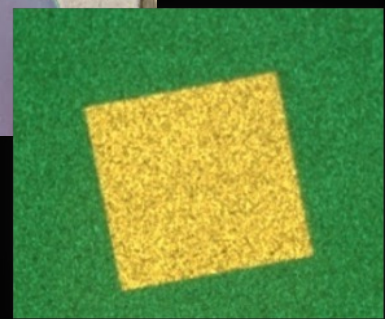
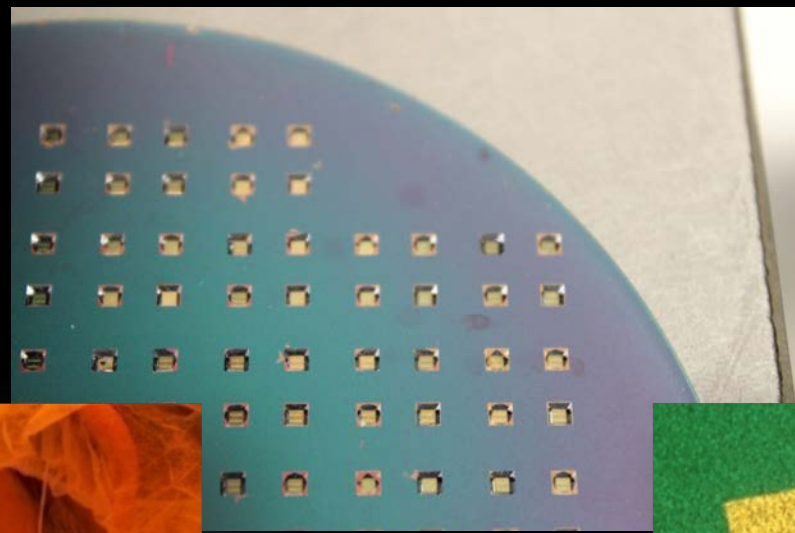
Wheatstone Bridge based pressure sensor



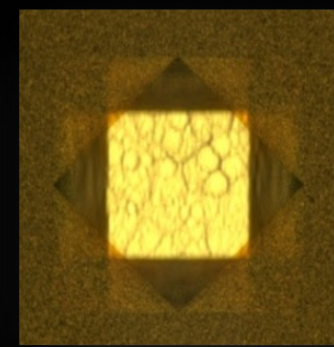
Pressure Sensor Process

- Two – mask layer process
- Backside (chamber) pattern
- SiN Etch (DRIE)
- Frontside (Wheatstone Bridge) pattern
- Sputter Deposition
- Liftoff
- KOH Anisotropic Etch
- Characterization

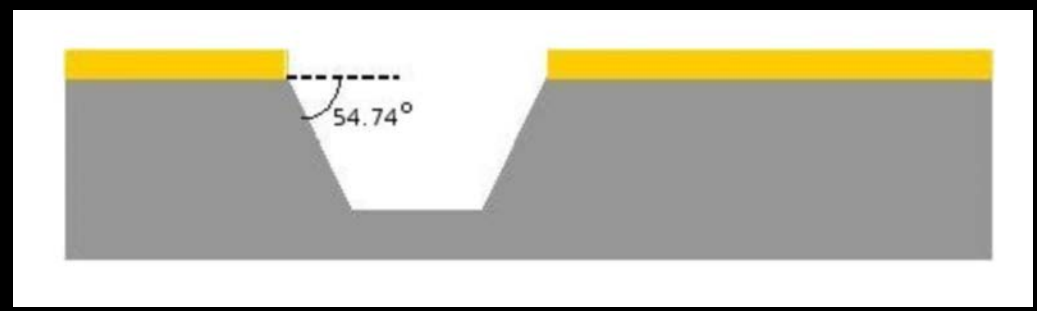




Before Etch



After Etch



PROCESS CHARACTERIZATION EXAMPLES

ETCH – WET, DRY, DRIE

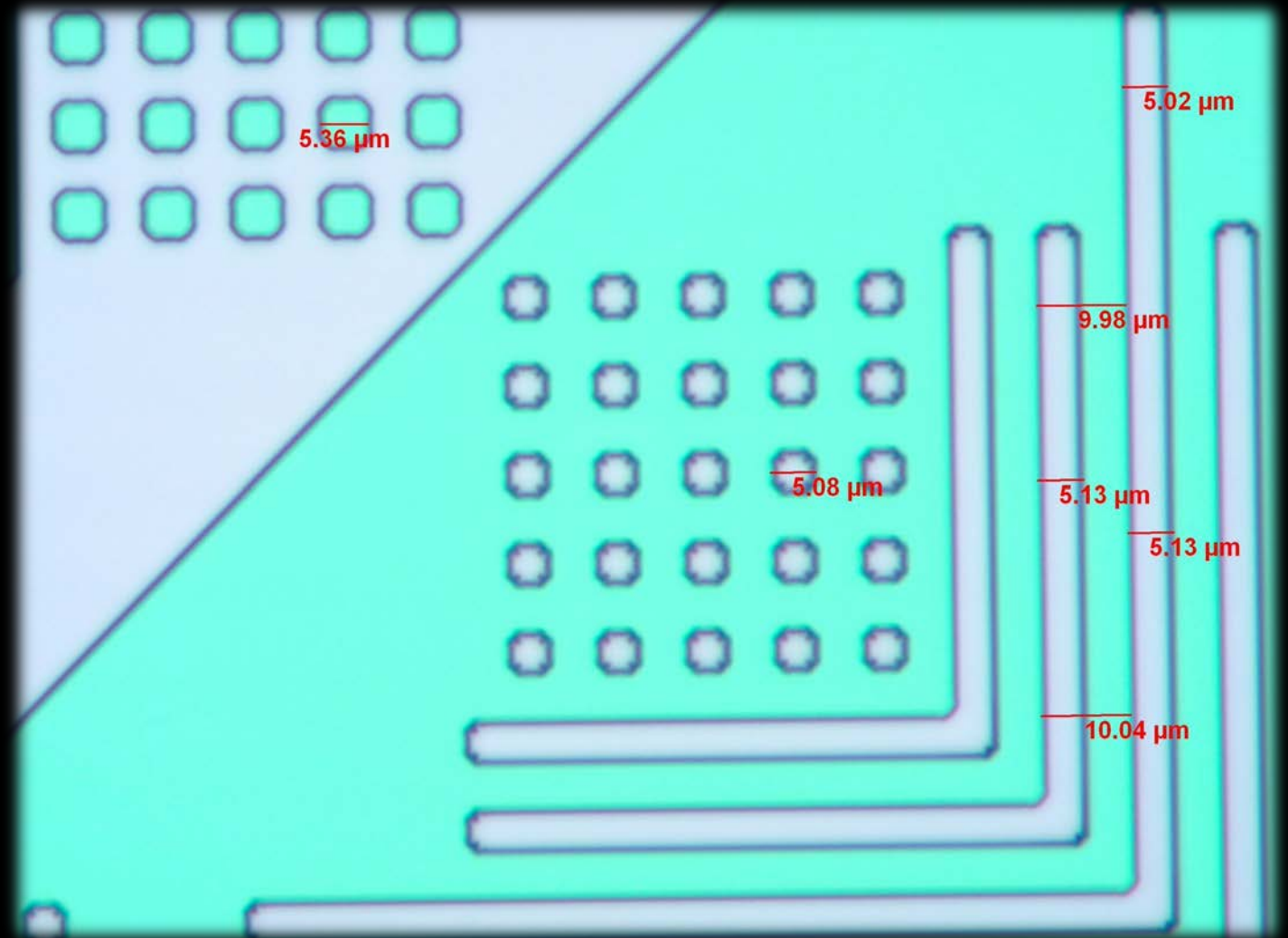
- RATES
- SELECTIVITY
- PROFILES

LITHOGRAPHY

- DOSE TO CLEAR
- CD VS MASK (BIAS)
- SOFT BAKE VS PHOTOSPEED
- SPIN SPEED CURVES
- POST EXPOSURE BAKE VS RESIST PROFILES

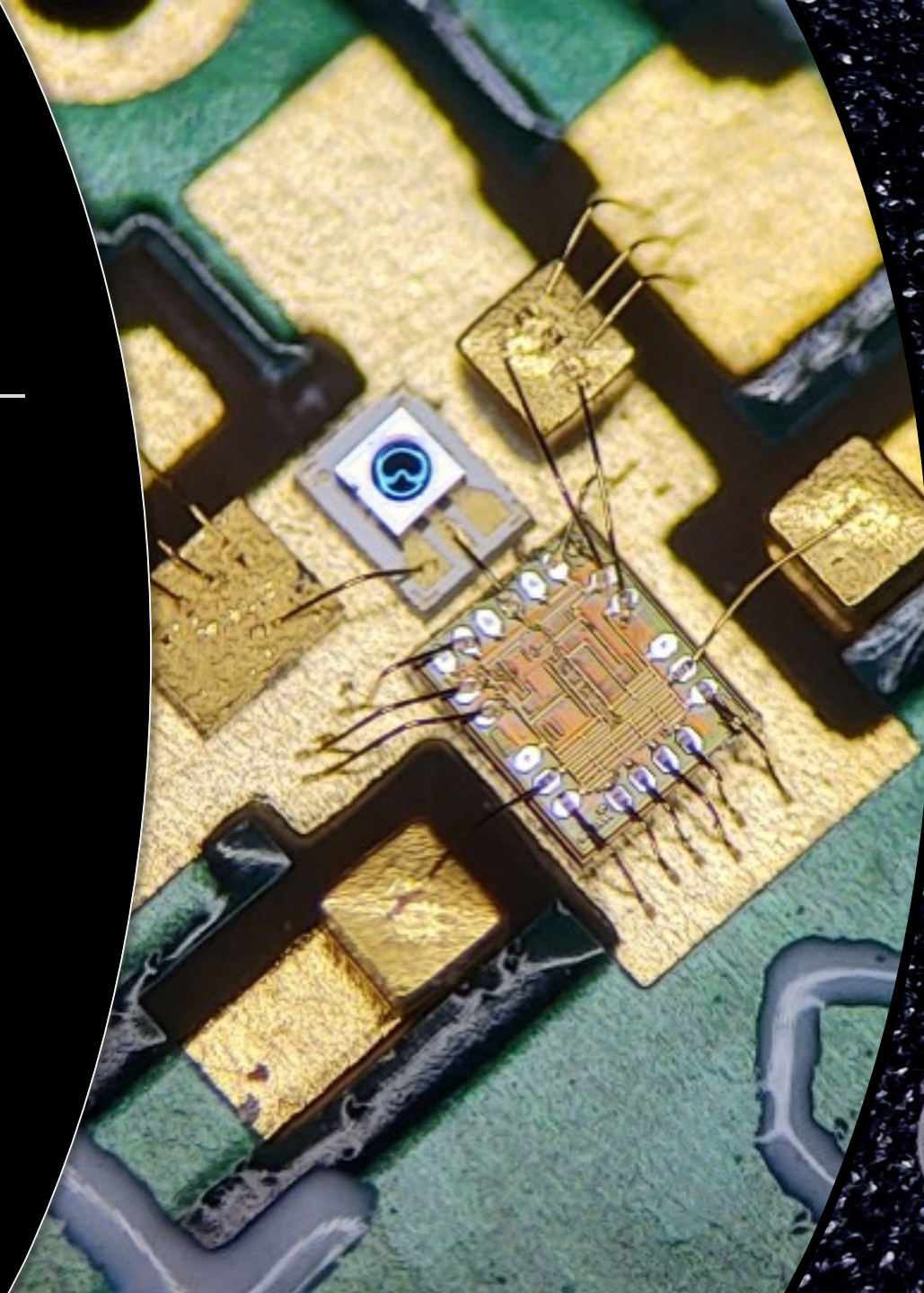
DEPOSITION

- OXIDE GROWTH
- SPUTTER



Testing and Packaging

Dr. Bernardo's Expertise



The logo for the National Science Foundation (NSF) is centered on the left side of the image. It consists of a blue and green globe with the letters "NSF" in white, serif font overlaid on it. The globe is surrounded by a golden sunburst pattern with multiple points. The entire logo is set against a light gray background that transitions into a dark gray background on the right side of the image.

NSF

Projects

Support Center
for Microsystems
Education
2004-2025

We still keep the website active

www.SCME-Support.org



SCME

SCME History

- Support Center for Microsystems Education
 - 2004 The Southwest Center for Microsystems Education, ABQ TVI
 - 2008 - Moved to the University of New Mexico
 - 2011 - MNT Annual Conference – collaborated with NSF ATE Centers
 - 2017 - Support Center with Lone Star College
 - 2018 - MNT^eSIG – Supplemental Funding for additional conference support
 - 2019 – funding for the URE project
- Prime CC Partners across the country
 - PCC, Rio Salado, Ivy Tech, Lone Star

SCME
Support Center for Microsystems Education

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Who is Online

We have 136 guests and no members online

ONLINE COURSES

YouTube

Dr. Pleil with Student at the MTTC - Teaching students about Microsystems Fabrication

Southwest Center for Microsystems Education **scme-support.org** Watch later Share

BioMEMS

DNA Capture Probes

Target DNA

Cell Membrane

ADP + P_i ATP

Outside the cell

SCME

Micro Nano Technology Education Center – MNT-EC

- UNM is a sub-awardee
- Lead by Jared Ashcroft,
Pasadena City College

2000-2010



UNM MTTC Supports:

- BILT
- Work with NIIT National Talent Hub,
SEMI, Micron, Intel, TI
- Provide PD and URE opportunities at
UNM's MTTC for faculty and students
- Co-develop Process & Eq KSA's
- We Lead UUCC
 - (Now WaferWorkforce.org)

What we support

- Educational Materials
 - Downloadable from www.SCME-Support.Org
 - Asynchronous online Short Courses
 - Hands-on Kits
- Professional Development
- Undergraduate Research Experience
- Mentor and Support MNT education and the newly funded MNT-EC
- YouTube Channel
- Online and F2F Conferences



Professional Development & Outreach

- Support Faculty Professional Development with Cleanroom 1-week Pressure Sensor workshops.
- Conference workshops, webinars and one-to-one activities
- Fab tours, RAIN Sessions, speaking at STEM events



URE - Undergraduate Research Experience Targeting 2yr technician students



MNT^eSIG COMMUNITY

Our Mission

Foster collaboration between educators at all levels, industry, and agencies for relentless improvement of the micro and nano technology workforce.

MNT^eSIG

MICRO NANO TECHNOLOGY
education
SPECIAL INTEREST GROUP

MICRO NANO TECHNOLOGY EDUCATION SPECIAL INTEREST GROUP

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Micro Nano Tech education Special Interest Group

MNTeSIG.net

[Congratulations to Jared Ashcroft and the MNT-EC Team!](#)

[Learn more about this NSF ATE funded endeavor!](#)

[Check out the MNT-EC Professional Development Webinar Series](#)

[Join the Collaboratory below to receive meeting information](#)

Our Mission

Foster collaboration between educators at all levels, industry, and agencies for relentless improvement of the micro and nano technology workforce.

MNT INDUSTRY MAP

Constantly updated

Over 3000 companies listed – see if yours is on it! Includes emerging and related high-tech companies

Students find jobs

Educators find regional Industry's

Industries find other industries and colleges (being added)

Industry Overview

Last Updated September 2020

Interested in contributing to the MNT^eSIG Industry Team? Check it out at MNTeSIG.net

Click on a state to see the Micro Nano Technology, Semiconductor & Other Electronic Component Manufacturing Related Industries.

Please Click on Your State Below:



About Micro and Nanotechnology

Current Projects

Current Grant Projects

- MNTEC (NSF)
 - CEET (NSF)
 - IGE (NSF)
 - Intel
-
- Support CNM ET and Mechatronics courses

• In the works

- NNME (with Gunny & CNM)
- Several other NSF proposals
- Intel Fellowship

WaferWorkforce.org – under construction

Consider us in your Grant Proposals

We will assist in grant development/equipment justification and how to budget for cleanroom access

We will install and place your Micro/Nano related equipment in the cleanroom

We will Maintain your equipment

Your equipment can be shared with other researchers and students for the benefit of UNM

Are latest collaboration – Kirk Lesker 5 gun Sputter tool (Nathan)

HAVE YOUR STUDENTS TAKE OUR
CLASSES TO BETTER EQUIP THEM
FOR RESEARCH – FREE TRAINING

