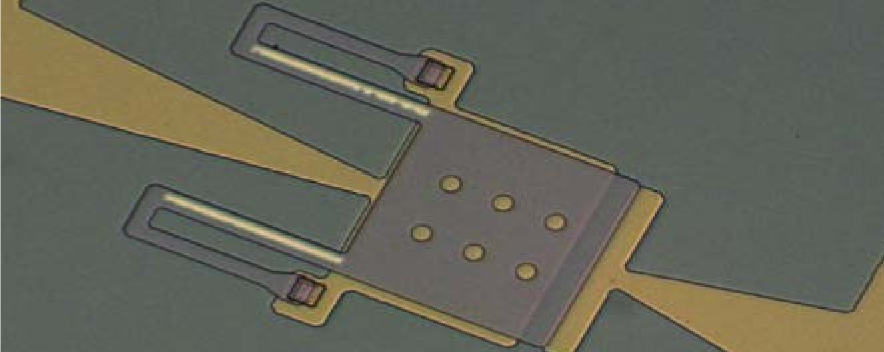
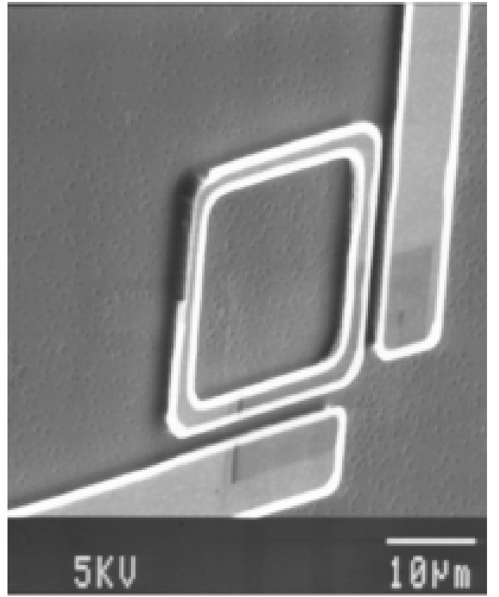
UCF Physics Shared Facilities

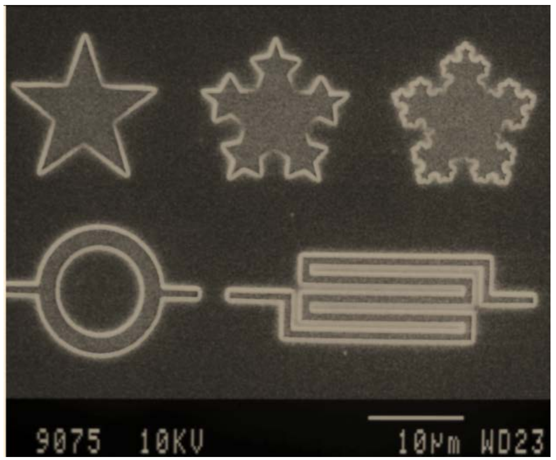
- What can we do?
  - Wafer-scale fabrication including MEMS, opto-electronics, nano-photonics, semiconductor devices, microfluidics, etc.
- *User* facility
  - Open to campus and community
  - Low fees
- Point of contact
  - Prof. Robert E. Peale, robert.peale@ucf.edu, 407 256 9884.

Central Florida Nano Fab (Physics)
From empty room to devices in 12 months

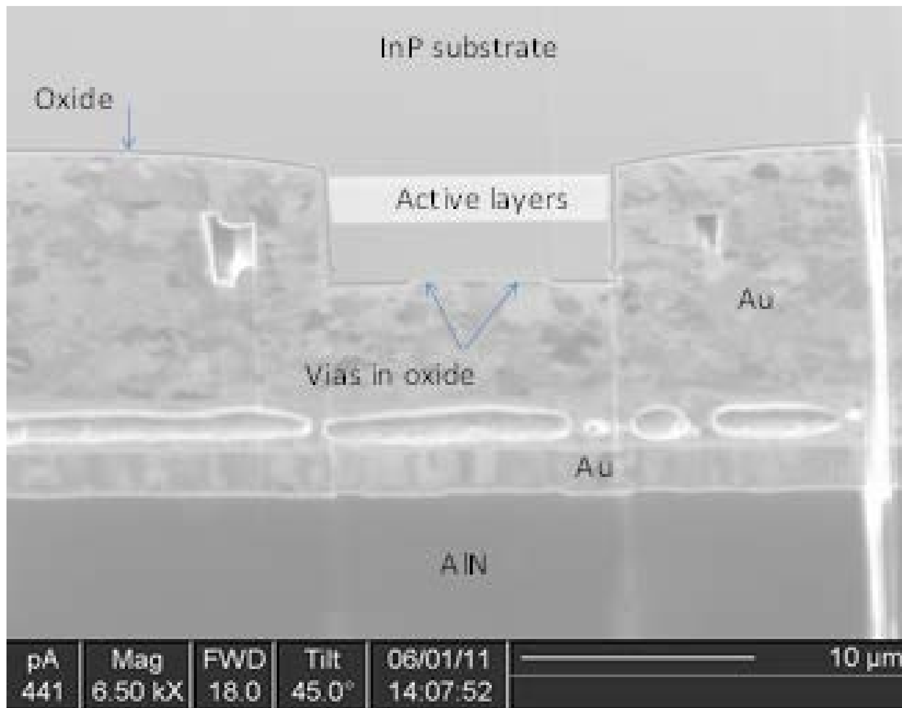
MEMS and Nanophotonics



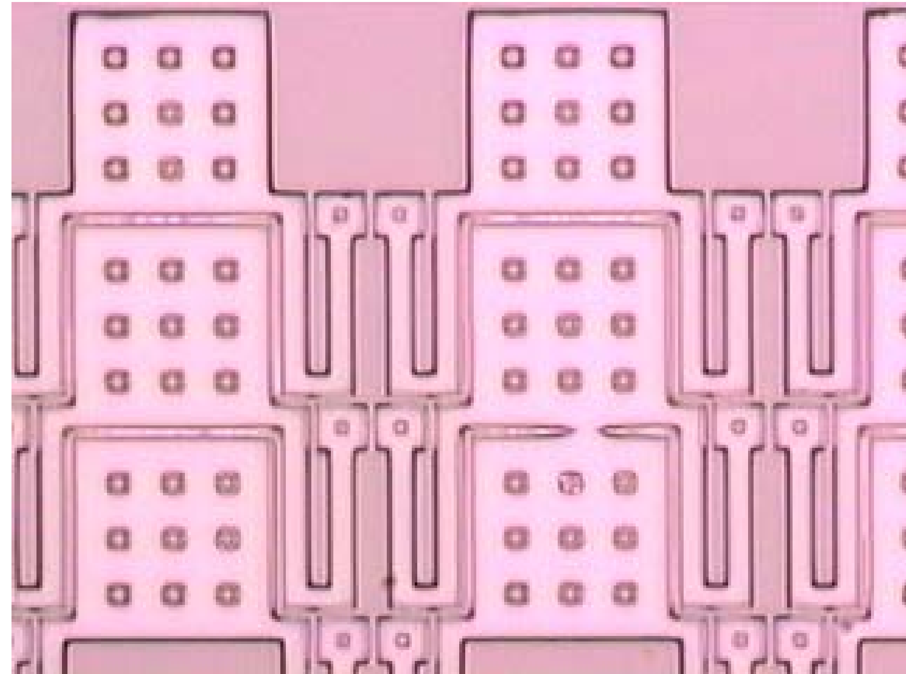




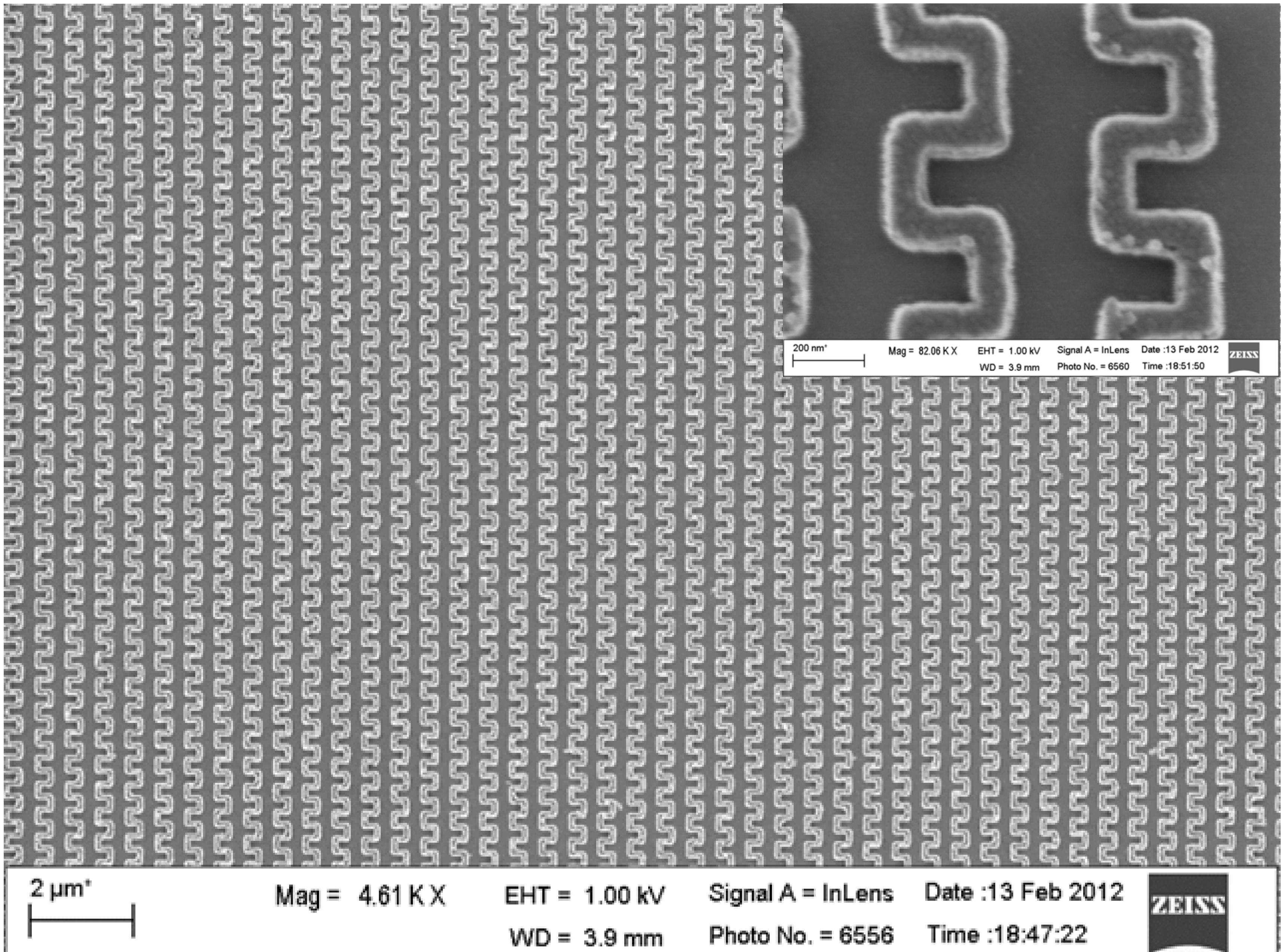
Quantum cascade lasers



Array bolometers



Plasmonics, Inc. “Meander line polarizer”



Plasmonics

10 µm*

Mag = 1.64 K X

EHT = 5.00 kV

WD = 10.6 mm

Signal A = SE2

Photo No. = 4541

Date :9 Aug 2013

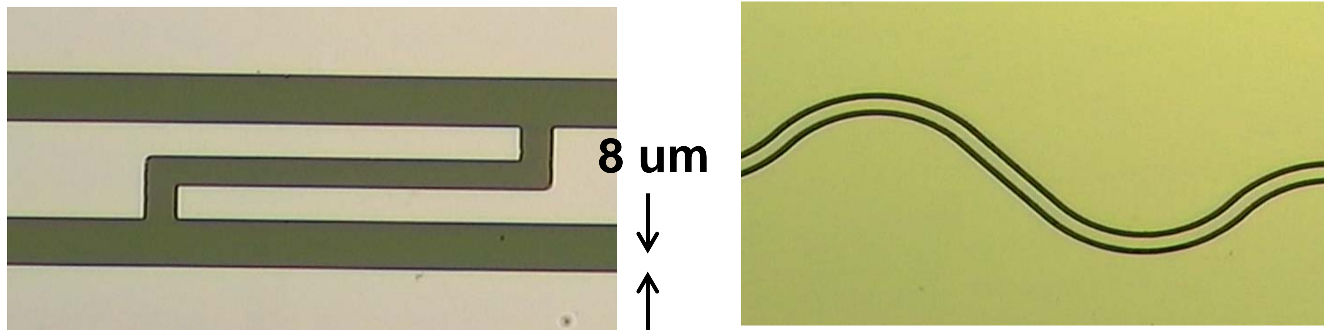
Time :16:03:47

Single-electron transistors

4 um

100 nm

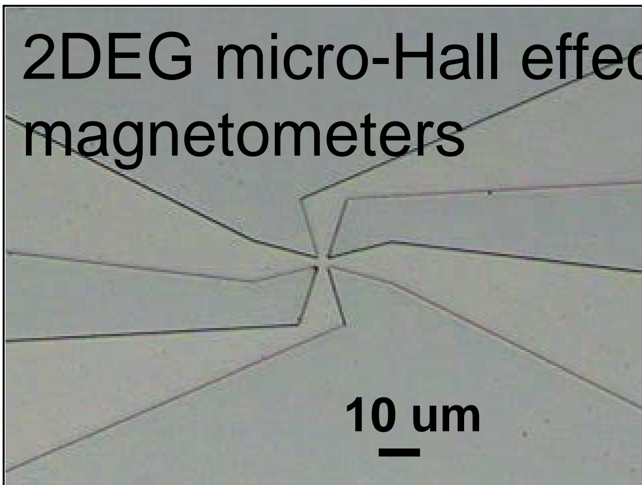
Superconducting microwave resonators

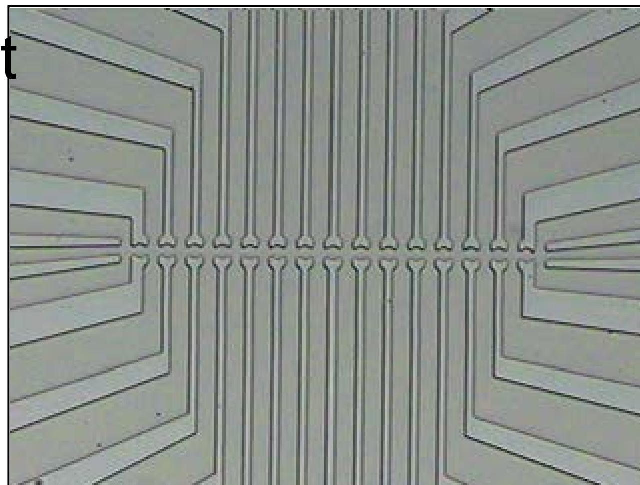


Del Barco Group

Microwave superconducting coplanar waveguides

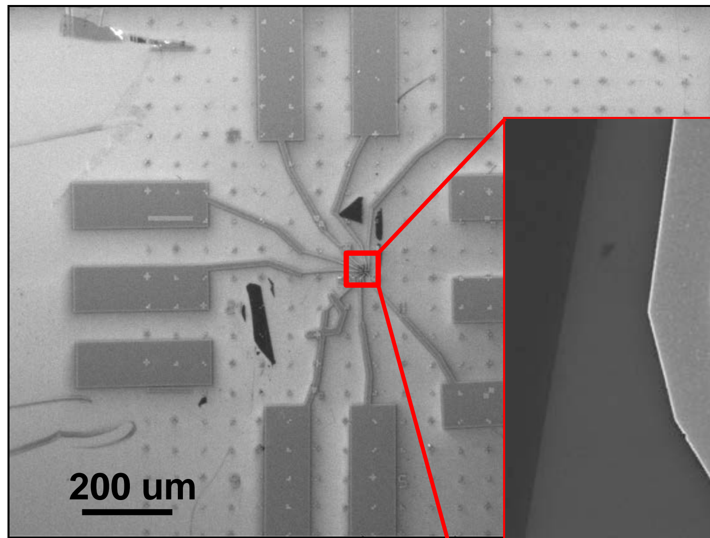
8 um

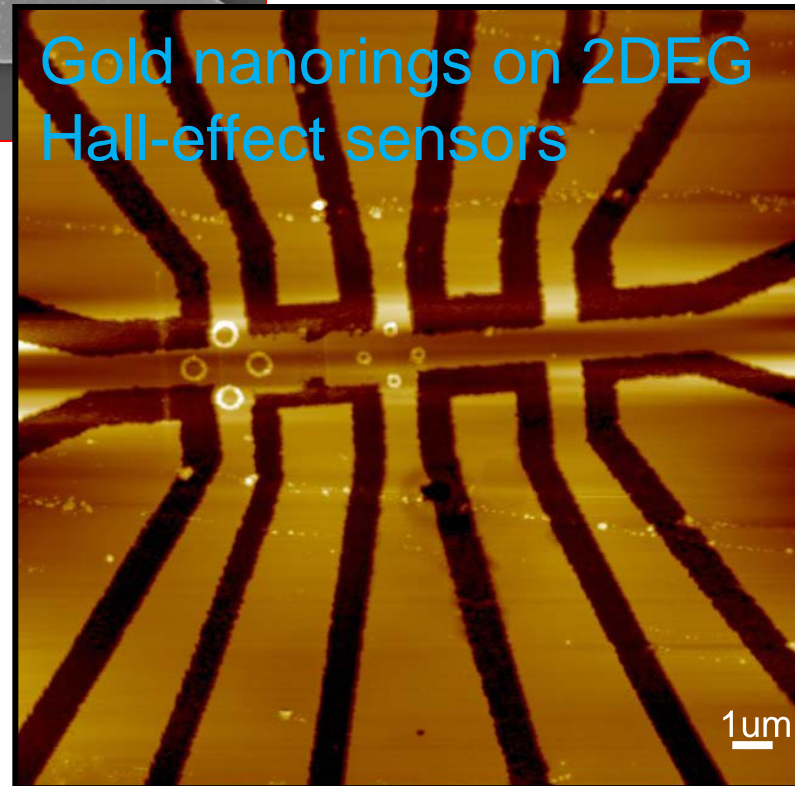




Del Barco Group

Graphene-based transistors





Del Barco Group

Photolithograpy

Spin Coater

- Headway PWM32-PS-R790
- Programmable Controller
- 10,000 RPM Motor
- 15” Diameter Steel Bowl
- Vacuum Chuck
- Vacuum On/Off valve

Hotplate

- **VWR® Standard** 4" x 4" (10.2 x 10.2 cm) Aluminum top
- digital display
- 5°C (above RT) - 400°C.
- adjustable in 1°C increments
- beeps at set point

Mask Aligner

- **OAI Series 200**
- 5” Masks
- Up to 4” Wafers
- 5x,10x,20x objectives
- Nominal 1 um Resolution
- 3 um Accuracy
- Vacuum contact
- Hard Contact

Metal deposition and lift-off

Electron Beam Evaporator

- 4 interchangeable pockets under vacuum
- Controllable Purge Port
- Sweep Functionality
- Ultra High Vacuum Cryopump
- Maximum Power:8kW
- In clean room

Electron Beam Evaporator

- 4 interchangeable pockets under vacuum
- Maximum Power:3kW
- Ultra High Vacuum Turbo Pump
- Outside clean room

Sputter System

- DC Magnetron with RF generator
- Depositions of metals and some dielectrics
- 4 interchangeable targets under vacuum
- Currently supporting Au, Ni, and other targets

E-beam/thermal evaporator with sputter guns

Sputtering system

- **Cressington 108**
- Chamber size: 4.75" x 4.75“
- Sputter head:
  - Low voltage planar magnatron
- Sputter target: Au
- Vacuum, Atm - 0.001mb Current, 0 - 50mA
- Manual gas and current control
- Digital timer, 5 - 300 seconds with pause

Sonicator

- **Branson B5510**
- Maximum control of cycle time up to 99 minutes
- Maximum control of bath temperatures to 70°C.
- Tank: 11.5" x 9.5" x 6"
- Frequency: 40 kHz

Materials growth

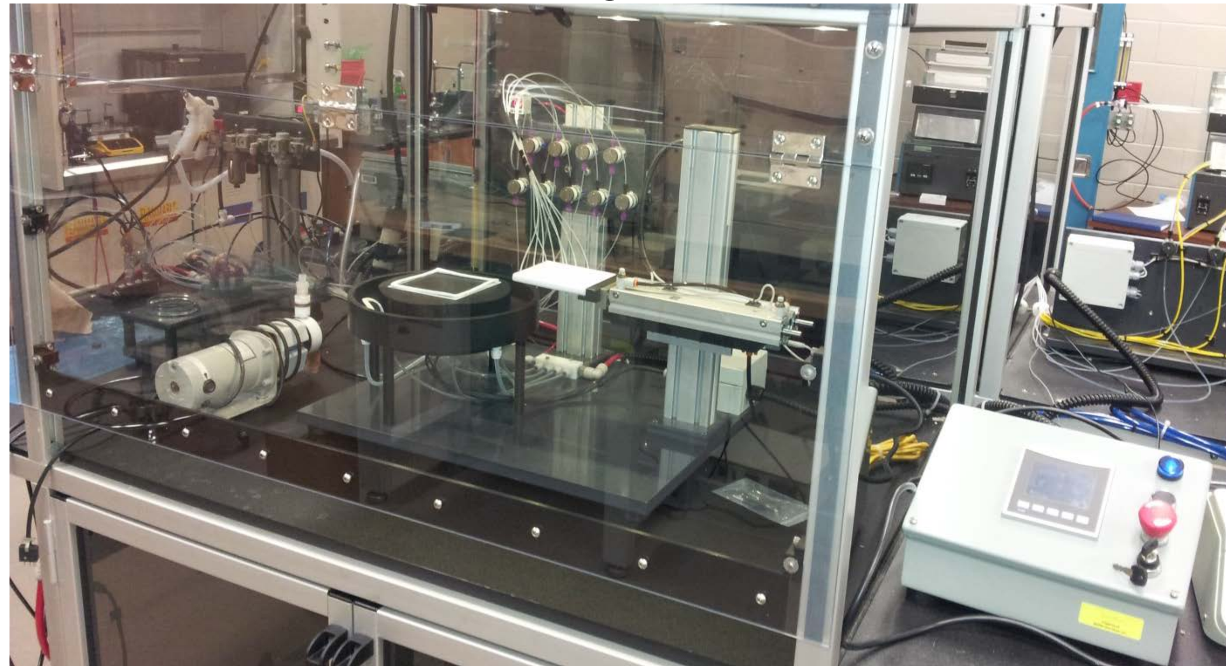
Plasma Enhanced Chemical Vapor Deposition

- **Trion - Orion II**
- Oxide Deposition w/ TEOS He bubbler unit
- Dual Frequency RF: 600W @13.56MHz & 100kHz
- Substrate Temperature controlled: RT-500°C
- Base Pressure: 60 mTorr
- Supported gasses:
  - CF_4, O_2, He (TEOS), N_2

Chemical Spray Deposition

- Metals
- Glass (amorphous oxides)
- Metal oxides
- Sulfides
- Deposition of other complex solid-state materials
- Composite materials
- Binary through hexanery compositions

LCD flex displays
LEDs
Lens coatings
Electrolyte films
Engineered optical film stacks
Thermochemical barrier and erosion-resistant/high hardness coatings
Ambient environmental barriers
Passivation of glass and metal vessels



Dry Etching

Barrel Etcher

- **BRANSON/IPC**
- Low Temperature Isotropic Etcher
- 13.56 MHz RF Generator 500 W max
- Quartz process chamber 10 in. dia. x 20 in. deep.
- Supported Gasses: CF_4 & O_2
- Base Pressure: 60 mTorr

Reactive Ion Etcher

- Samco RIE-1C
- Reactive Ion Etcher
- Operating Frequency: 13.56 MHz
- Maximum Power: 200 Watts
- Supported gases: CF4, Ar, O2
- Base Pressure: 15 mTorr

Reactive Ion Etcher with Inductively Coupled Plasma

- **Trion – MiniLock II**
- He substrate cooling
- Gasses: O_2, CF_4, Ar
- Water cooled RF
  - 600 W 13.56 MHz
- Automatic
- Labview interface
- Load lock

Deep Reactive Ion Etcher

- STS
- Inductively Coupled Plasma Processes
- Unit with load lock
- Bosch Process
- Supported Gasses:
  - SF_6, C_4F_8, Ar, O_2, CF_4

Other device processing tools

Critical Point Drier

- **SPI-DRY™**
- Manual operation
- Range:
  - 0-2000 psi
  - 0° - 50° C
- Inside dia:63.5 mm
- Inside length:82 mm

Rapid Thermal Annealer

- Max 1200ºC
- Manual and Auto

Tube Furnace

- **Lindeberg**
- Maximum Temp: 1200C

Tube Furnace

- **Lindeberg**
- 3ft x 3”dia tube
- 3 heating zones
- Maximum Temp:
  - 1500°C

Oven

- **Blue M – Cavity Oven**
- Max temperature:
  - $1000^{o}C$
- Cavity Dimensions:
  - 5.25”w x4.5”h x14”d

Wire Bonder

- **West Bond 7400C**
- Ultrasonic wire bonder
- Manual
- Timer/Power Programmable

Wafer Scriber

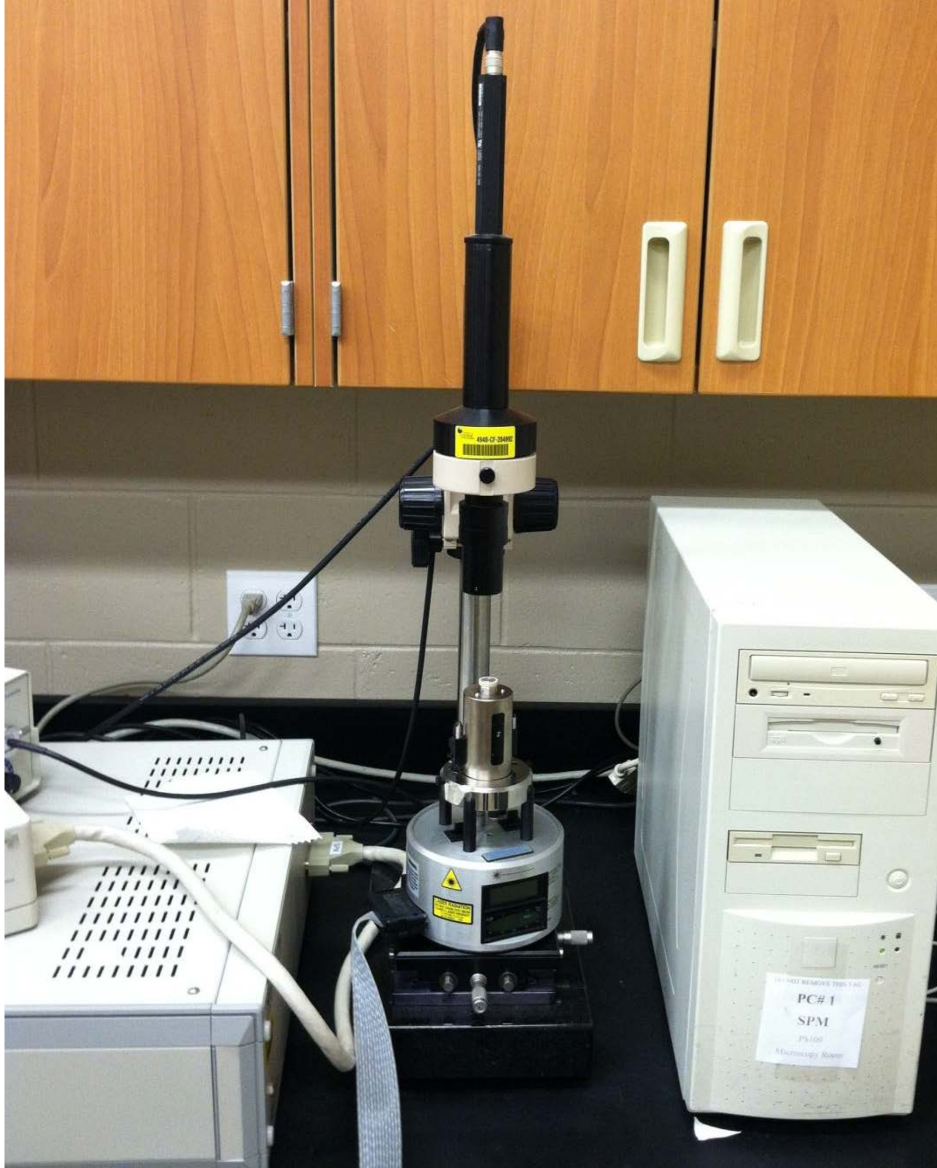
- **Karl Suss**

Characterization

Atomic Force Microscope

- **5000 Digital Instruments**
- provides full 3D data
- Motorized stage
- programmable measurements up to one hundred areas on samples (max 200mm dia)
- scan length ~100 um to a few nm
- 16-bit resolution
- Modes of operation:
  - Contact Mode
  - Electric Force Microscopy (EFM)
  - Lateral Force Microscopy (LFM)
  - Magnetic Force Microscopy (MFM)
  - PhaseImaging
  - Scanning Tunneling Microscopy (STM)
  - TappingMode

Atomic Force Microscope

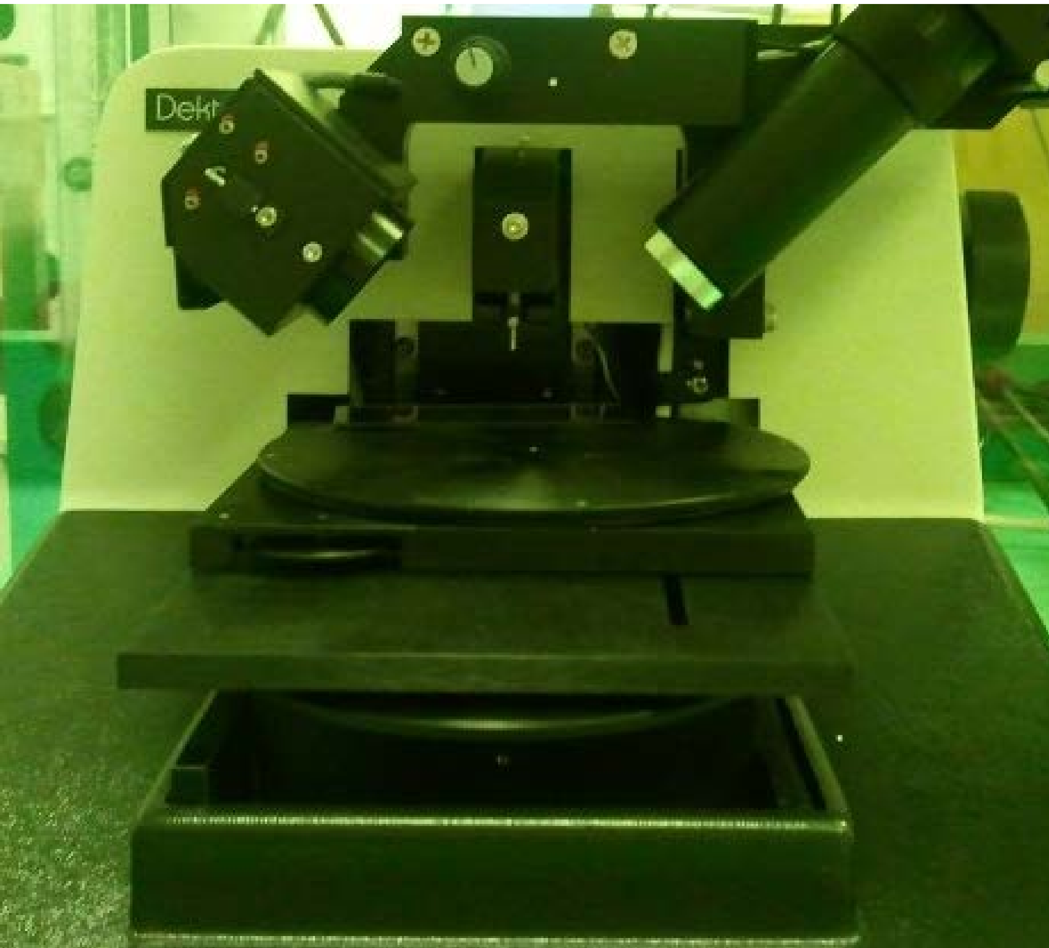


- Digital instruments

Optical Microscope

- Digital CCD video camera w/ software interface
- Bright Field
- Supports up to 3 light sources
- 5, 10, 40, 100 x objectives

Profilometer



- **Dektak 3**
- contact stylus surface profiler
- vertical height res: <100 angstroms - 655,000 angstroms
- Single Scan and Multi-line Scan

Probe Station

- **Kramer Microscope**
- 10x objective
- 4 probes
- Au plated 1mil (25.4 micron) radius tip
- Video camera

Hall Effect

- **Walker Scientific**
- Programmable
  - Voltage
  - Current
  - Temperature
- Maximum Field
  - 7.415 kG

Scanning Electron Microscope

- **JEOL: JSM-840A**
- accelerating voltages: 1,000 volts to 40,000 volts
- magnification: x10 to x 300,000
- 30 Ångstrom resolution (LaB6 source at 40KV)
- solid state backscattered electron detector
- Nabity e-beam lithography package

UV-Vis Spectrometer

- **Cary 500i**
- Optical absorption spectroscopy
- Wavelength range: 175nm-3300nm
- Powder, thin films and liquid samples
- PbS detector thermoelectrically cooled to 0 °C
- Many sampling accessories

Analytical Balances

- **Sartorius Supermicro**
- Weight pan with motor
- Double shielded
- 4 gram max weight
- 22 mm diameter pan

Processing Video

http://www.youtube.com/watch?v=2L6gw1O2z9Y