User-Facility Capabilities

Center for Optoelectronics and Optical Communications

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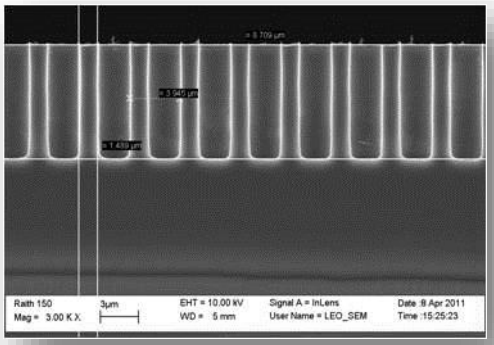
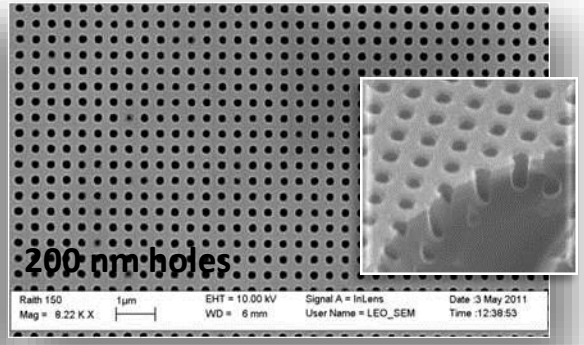
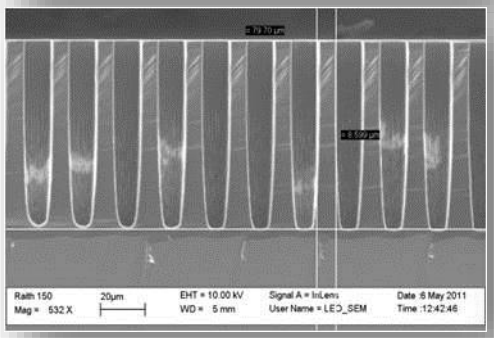
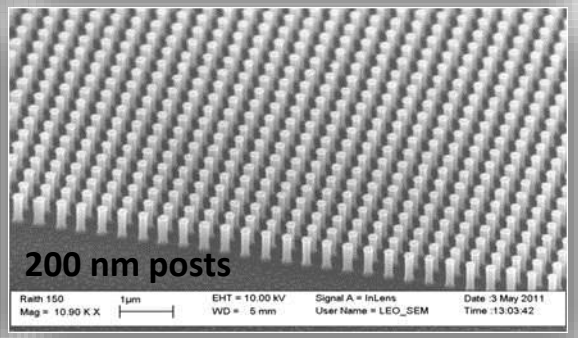
STS Advanced Silicon Etch (ASE) ICP

Contact: Robert Hudgins





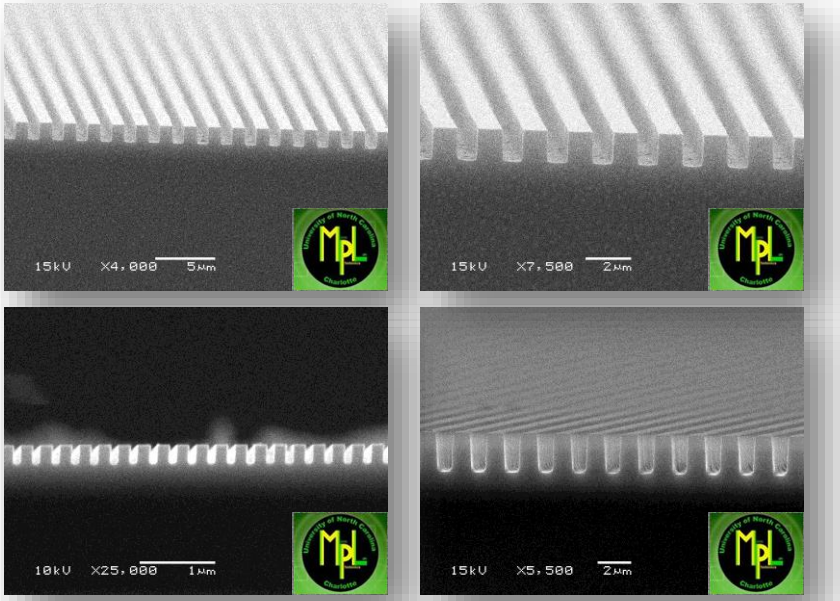




- **Process achieves high microns/minute rate anisotropic etching using the Bosch process**
- **Vertical etch depths of >0.5 mm**
- **Aspect ratios approaching 20:1**
- **Gases: C_4F_8, O_2, SF_6, Ar, He**

Deposition/ Etching

STS III-V Multiplex Pro ICP Etch System

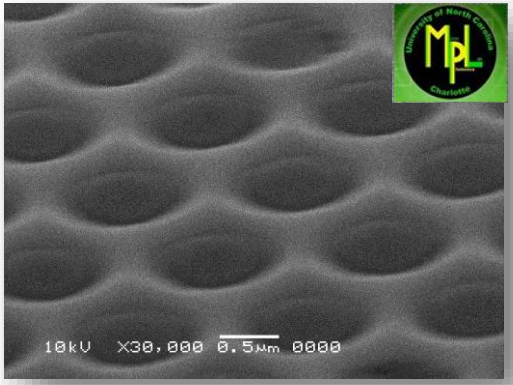


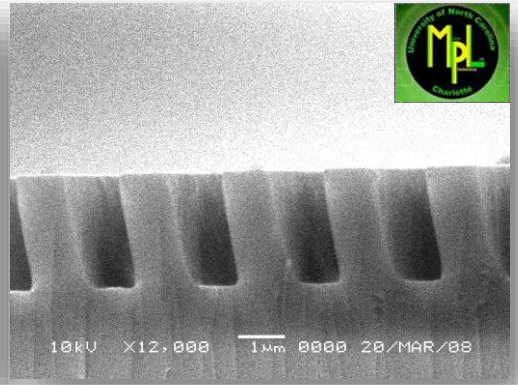
Contact: Robert Hudgins

- **Inductively Coupled Plasma system uses chlorine based chemistry to etch compound semiconductor materials such as GaAs, GaN, InP, GaP, SiC, and AL_20_3**
- **Uniform anisotropic etching of thin film materials**
- **Power RF generators**
- **Gases: Ar, O_2, SF_6, $SiCl_4$, He, N_2, Cl_2, BCl_3**

Deposition/ Etching

STS Advanced Oxide Etcher (AOE)



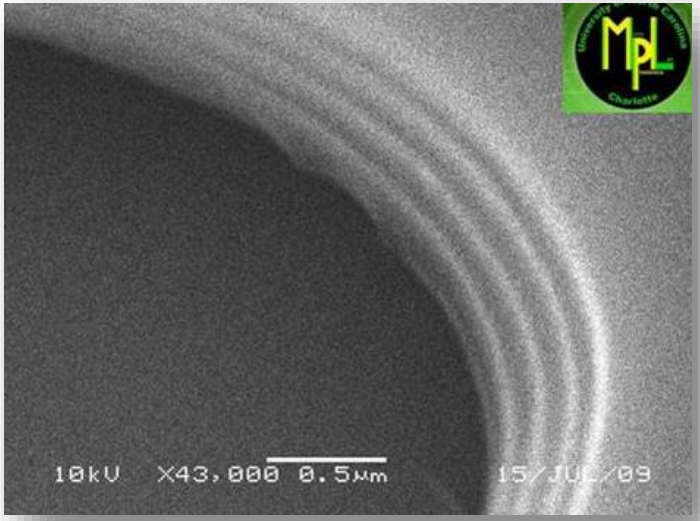


Contact: Robert Hudgins

- **Employs fluorine plasma chemistries to etch dielectrics, including SiO2 and Si3N4**
- **Available Gases: SF6, O2, C4F8, H2, CHF3, He**
- **RF Power:**
  - **Coil - 3 Kw at 13.56 MHz**
  - **Platen – 600 w at 13.56 MHz**

Deposition/ Etching

STS PECVD Multiplex Pro

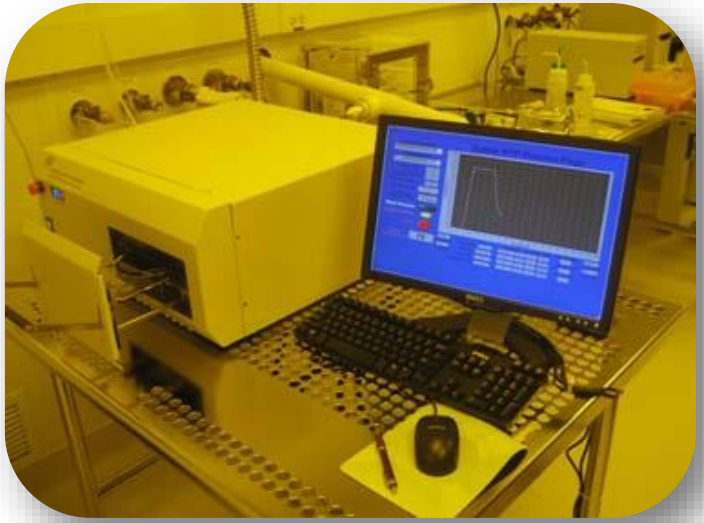


Contact: Robert Hudgins

- **High quality SiO_2, Si_3N_4**
- **Uses 100 mm substrates**
- **Low frequency and high frequency generation**
- **Gases: $C_4F_8O_2$, NH_3, N_2, N_2O, SiH_4**

Deposition/ Etching

SSI Solaris 150 Rapid Thermal Processor



Contact: Robert Hudgins

- **Process up to 150mm-dia substrates at a temperature range from RT-1000^{o} C**
- **Temperature Ramp-Up 25^{o}C/sec**
- **PID process controller ensures accurate temperature stability and uniformity**
- **Designed for silicon implant annealing and monitoring, compound semiconductor implant activation and ohmic contact alloying**
- **Gases: N_2, Ar, 0_2**

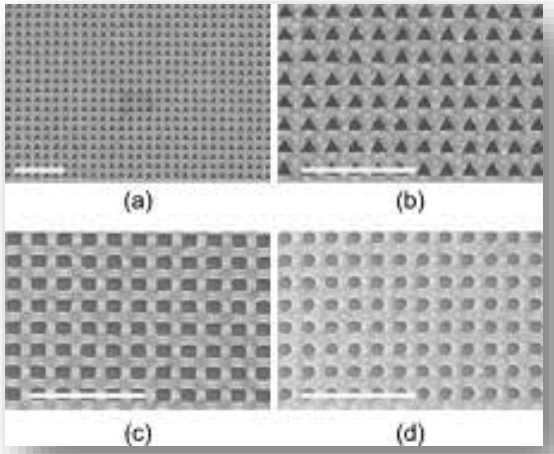
Deposition/ Etching

AJA ATC 1800-F Sputter Deposition System

Contact: Robert Hudgins

- **ATC 1800-F sputter deposition system**
- **Wafers up to 150 mm in diameter**
- **Single layer, sequential, or co-sputtered processes**
- **Platen can be rotated for enhanced thickness uniformity**
- **Gas: Ar**

AJA ATC 1500-F Ion Mill System



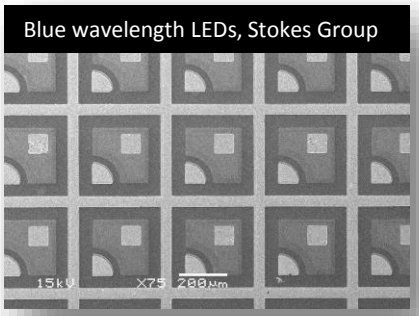
Contact: Robert Hudgins

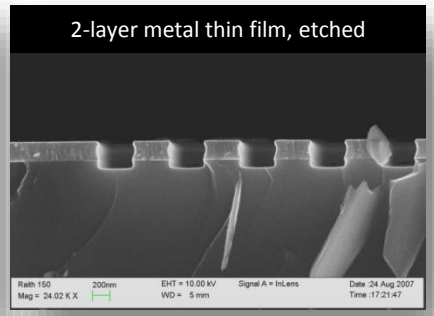
- **250 mm diameter ion source**
- **Process substrates up to 150 mm in diameter**
- **Two mass flow controllers**
- **Removes thin film materials that cannot be plasma etched**
- **Gases: Ar**

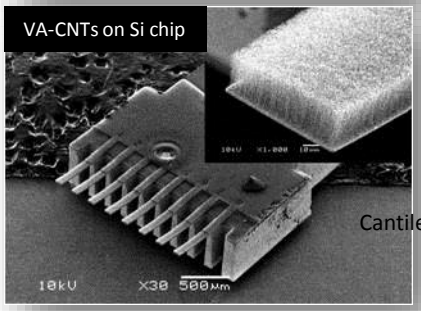
Deposition/ Etching

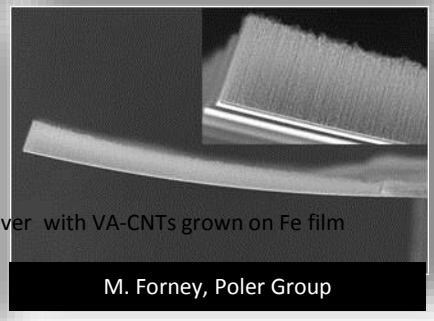
Lesker PVD 75 Thin Film Evaporation System

Contact: Lou Deguzman









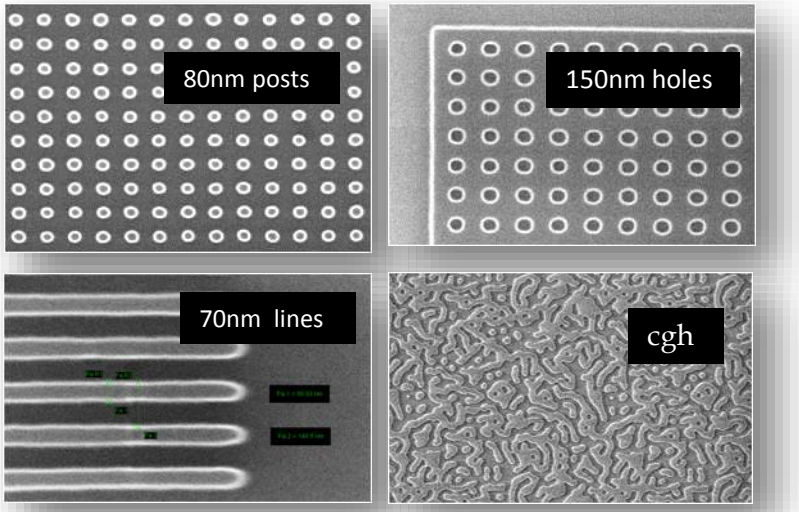
Cantilever with VA-CNTs grown on Fe film

M. Forney, Poler Group

- **Electron-beam and thermal evaporation system**
- **10^{-8} Torr Vacuum**
- **Capacity of processing three 100 mm wafers or a single 150, 200, or 300 mm wafer**
- **Runs in manual or automatic mode**
- **Up to 4 deposition materials**
- **Beneficial for lift-off metallization**

Deposition/ Etching

Imprio100 Nanoimprint System



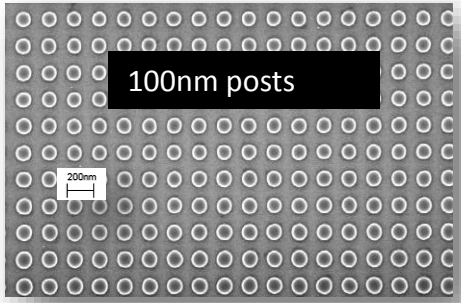
Contact: Lou Deguzman

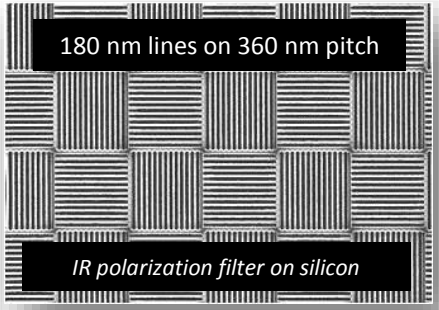
- **Step and Flash Imprint Lithography Technology**
- **Resolution : sub-50 nm**
- **Alignment : < 500 nm**
- **Wafer handling: up to 8-inch diameter wafers**
- **6”, 4” and 3” diameter wafer chucks available**
- **Field size : 25 mm maximum**
- **Mini-environment: Class 3**

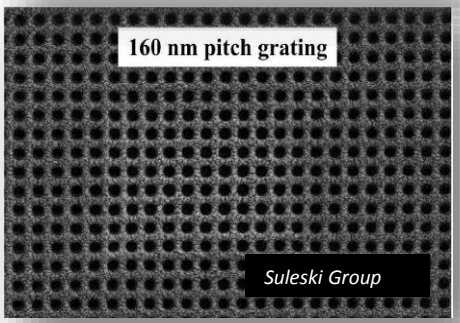
Lithography

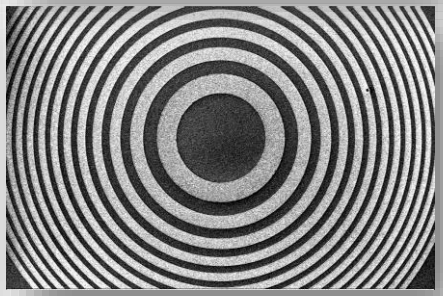
Raith 150 E-Beam Lithography System

Contact: Lou Deguzman







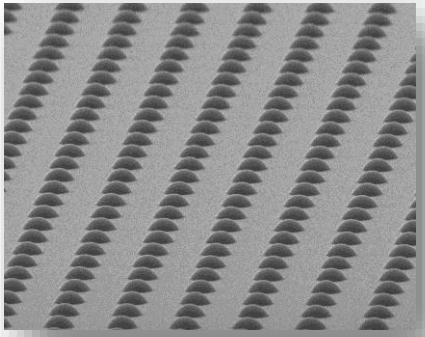


- **Ultra high resolution patterning**
- **Minimum feature size < 20 nm**
- **Overlay capability: < 60 nm**
- **Stitching capability: < 60 nm**
- **Magnification: 20x - 1,000,000x**
- **Ultra high resolution imaging**

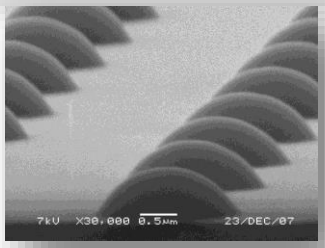
Lithography

Quintel Mask Alignment System

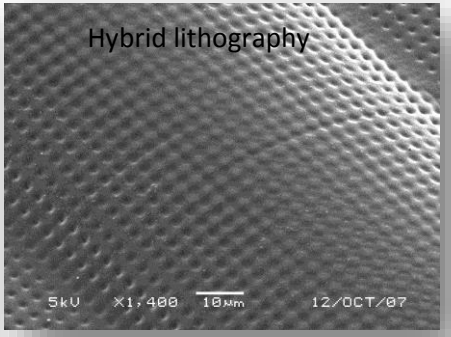
Contact: Lou Deguzman



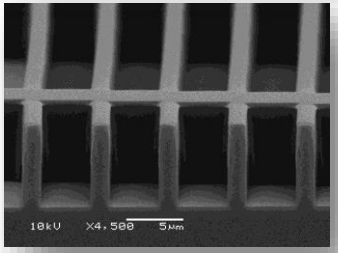
Reflowed Lenses



A. Cannistra, Suleski Group



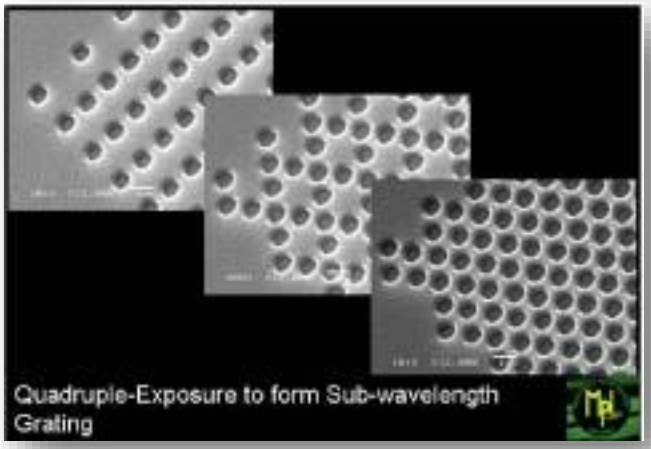
High aspect ratio SU-8 structures



- **For 100mm and 150mm wafers, and piece parts**
- **Vacuum, pressure, and proximity mask exposure**
- **Sub-um lithography in vacuum contact mode**
- **Split Field Alignment Microscope**
- **Overlay accuracy:**
  - **Frontside alignment: ~ 0.5 um**
  - **Backside alignment: ~ 1 to 2 um**

Lithography

GCA 5X Stepper

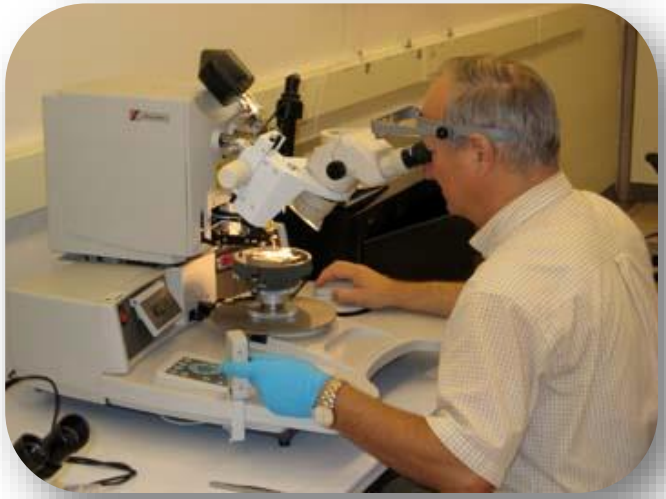


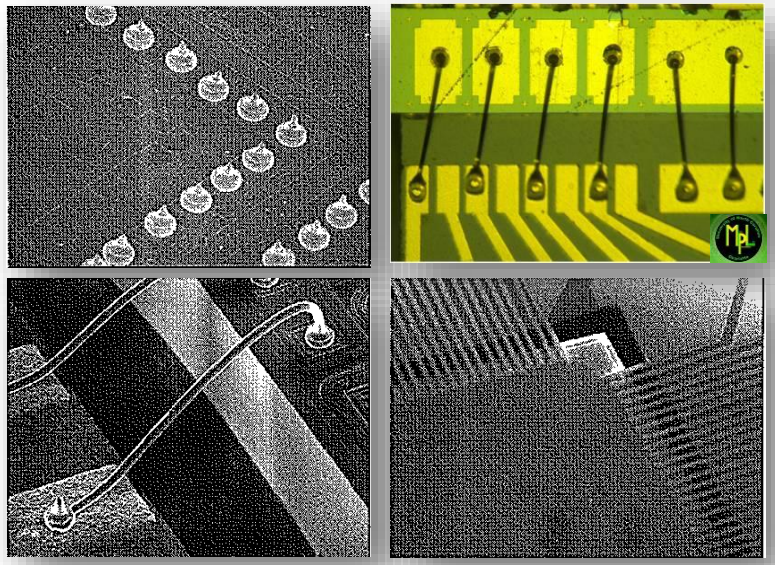
Contact: Robert Hudgins

- **5X reduction projection lithography tool**
- **G-Line 436 nm wavelength**
- **4” 1mm thick wafers, silicone and fused silica**
- **Single wafer chuck**

Lithography

K & S 4524 Digital Ball Wire Bonder





Contact: Robert Hudgins

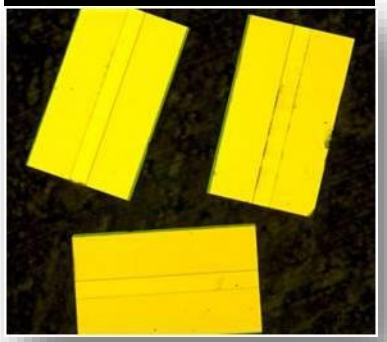
- **Ball-Wedge bonding wire capability**
- **Olympus microscope and spotlight targeting**
- **Deep access capability**
- **Flat substrate holder with built-in temperature controller**
- **Motorized Y axis and programmable auto-stepback function for precise wire length and loop formation**
- **Auto-2nd bond mode for complete single wire programmed sequence**
- **Digital readout of all parameters etc**

Packaging

Scribe and Break Tool, Loomis LSD-100

Contact: Robert Hudgins

Cleaved laser diode chips

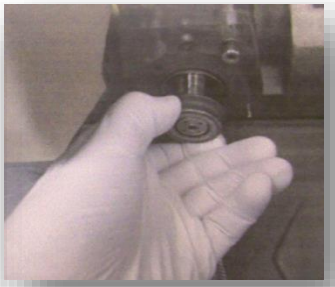


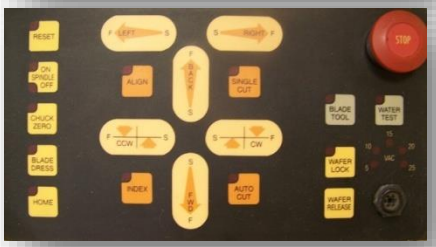
- **Precise (~10mm) Scribing and Breaking**
- **Roller-Style Breaker**
- **Motorized Rotation Control**
- **4" (100mm) Wafer Capability**
- **Color Camera**
- **Machine Control Software**

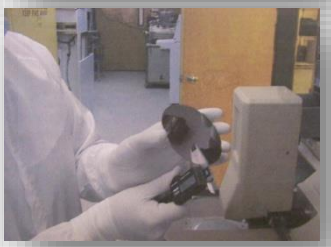
Packaging

Dicing Saw, MicroAutomation 1100

Contact: Robert Hudgins







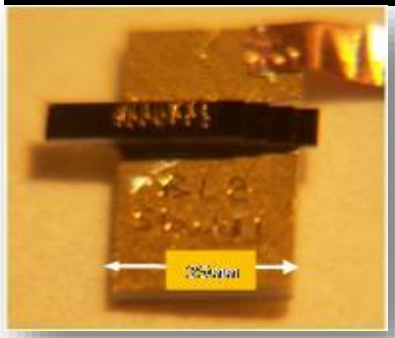
- **Programmable, Microprocessor-controlled, automatic saw for cutting semiconductor wafers and other hard material**
- **Split field video system for aligning wafers before cutting, for program and data display, and for monitoring**
- **Cuts maximum 150mm substrates up to 500mils thickness**
- **Spindle speed from 15000-40000 rpm**

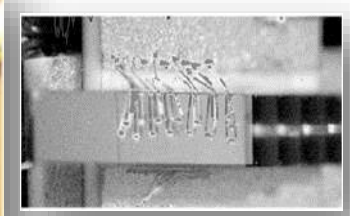
Packaging

FineTech Flip Chip Bonder

Contact: Robert Hudgins

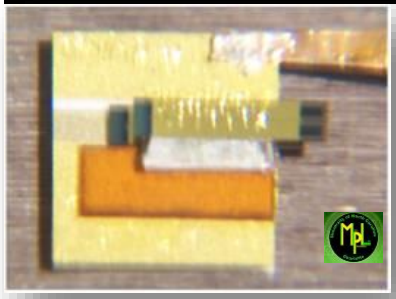
1D vertical stack of the surface-emitting devices





Device in operation

(2x2) 2D vertical assembly of the surface-emitters bars

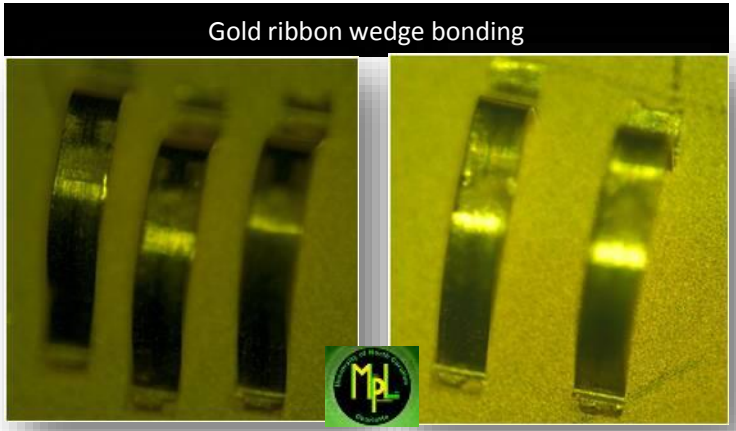


Device in operation

- **Flip-Chip bonding capability**
- **Substrates up to 50x50 mm^2**
- **Placement accuracy is ± 1.0 µm**
- **PC-controlled heating plate (up to 400^{o}C)**
- **Bonding force range: 0.1 N - 500 N**

Packaging

K&S Digital Wedge Bonding System

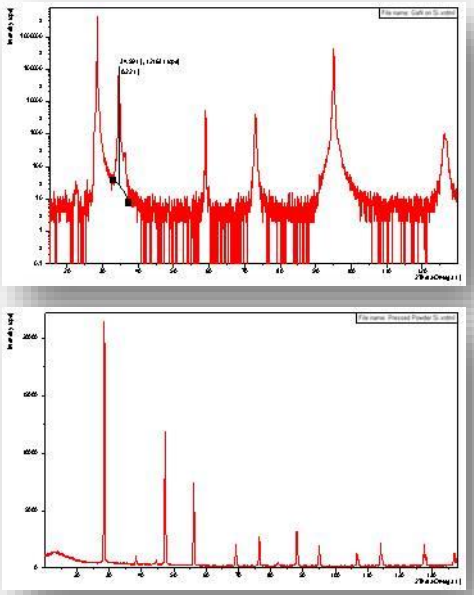


Contact: Robert Hudgins

- **Gold ribbon (≤250mm-wide) wiring for high-speed and high-current application**
- **Nikon microscope and spotlight targeting**
- **Deep access capability**
- **Flat substrate holder with built-in temperature controller**
- **Motorized Y axis and programmable auto-stepback function for precise wire length and loop formation**
- **Digital readout of all parameters**

Packaging

PANalytical X-Ray Diffractometer (XRD)

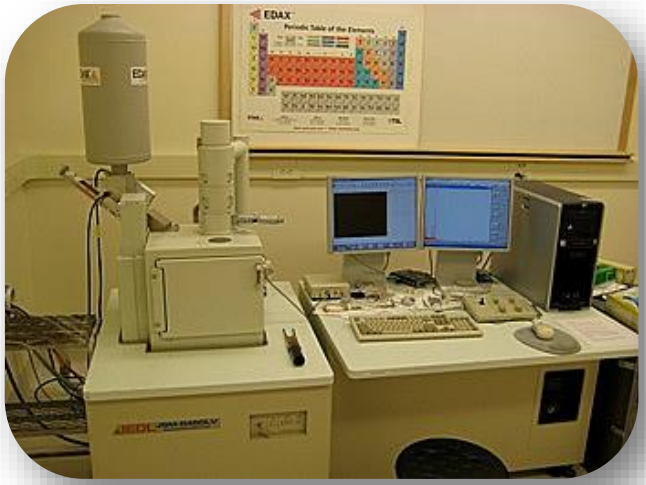


Contact: Lou Deguzman

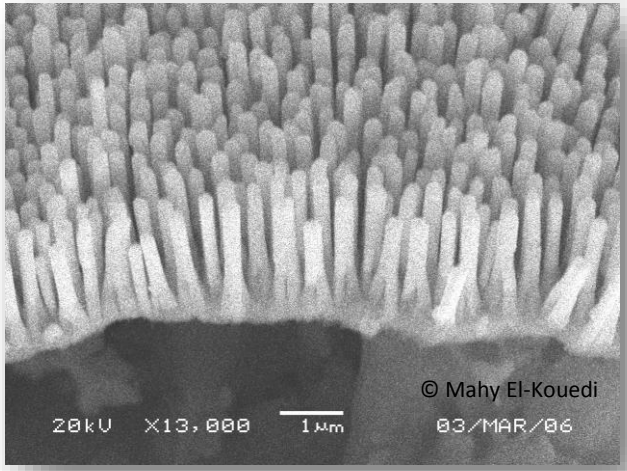
- **Advanced materials science and nanotechnology diffraction**
- **Metrologic characterization in semiconductor process development**
- **It can handle a wide range of applications, and is especially suitable for thin film analysis applications such as:**
  - **Rocking curve analysis and reciprocal space mapping**
  - **Reflectometry and thin film phase analysis**
  - **Residual stress and texture analysis**

Imaging/ Characterization

JEOL SEM w/EDAX



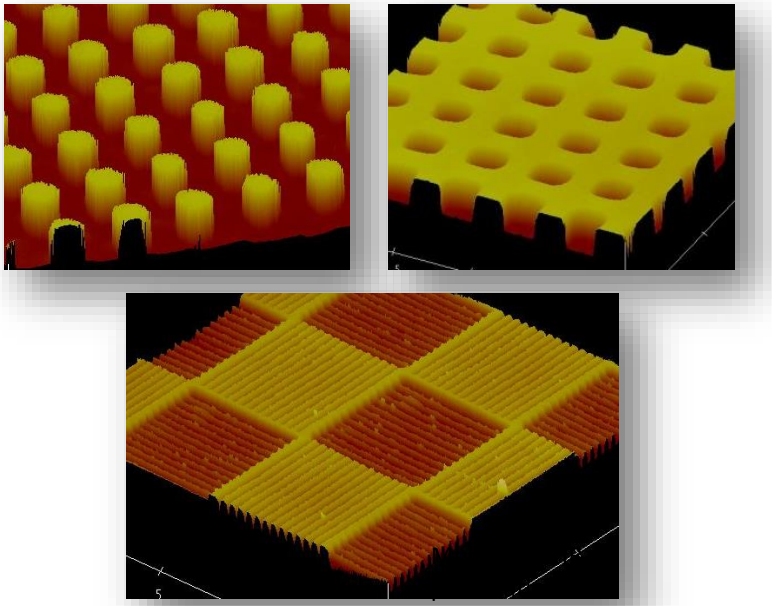
Contact: Lou Deguzman



- **Maximum Magnification: 300,000**
- **Resolution: 3 nm**
- **Capable of both high and low vacuum operation**
- **Acceleration Voltages: 0.3 Kv to 30 Kv**
- **System includes EDAX x-ray analysis for material characterization**

Imaging/ Characterization

Dimension 3100 SPM System with NanoScope IV Controller AFM

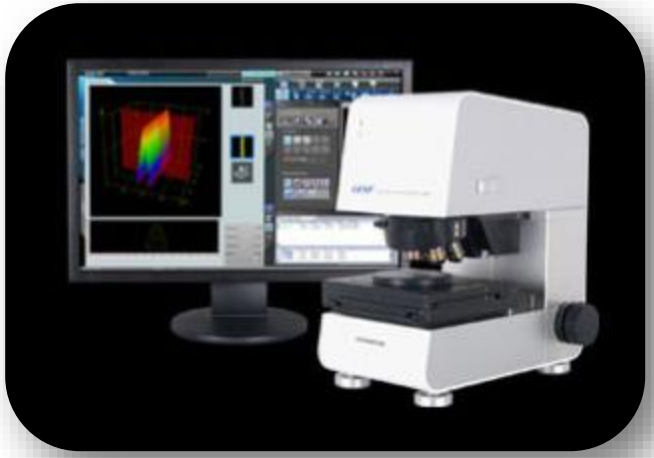


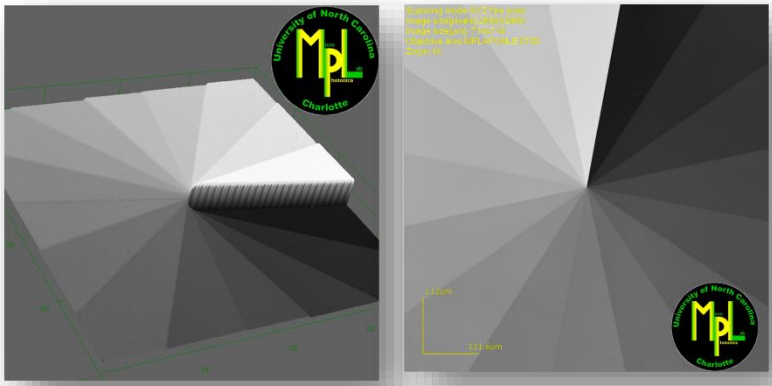
Contact: Robert Hudgins

- **Surface imaging technique for analyzing nanoscale and atomic structures**
- **Sub-nm Resolution**
- **Multiple scanning modes, including:**
  - **Contact**
  - **Tapping**
  - **Magnetic**

Imaging/ Characterization

3D Measuring Laser Microscope





Contact: Robert Hudgins

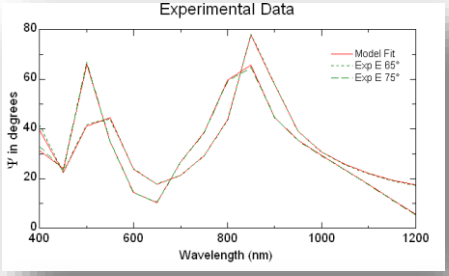
- **Seven Measurement Modes:**
  - Step Measurement
  - Surface Roughness Measurement
  - Area/Volume Measurement
  - Particle Measurement
  - Film Thickness Measurement
  - Under Geometric Measurement
  - Auto Edge Detection Measurement

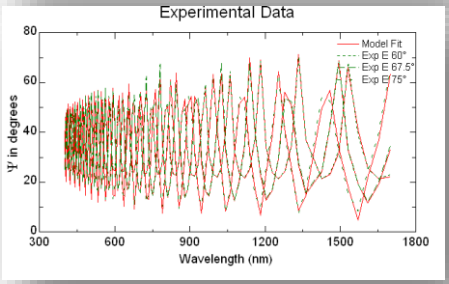
- **Five Key Laser Technologies:**
  - Under short-wavelength laser source
  - Confocal Optical System
  - XY Scan
  - Real Color Image Acquisition
  - Linear Scale Z-scanning

Imaging/ Characterization

VASE Spectroscopic Ellipsometer

Contact: Lou Deguzman



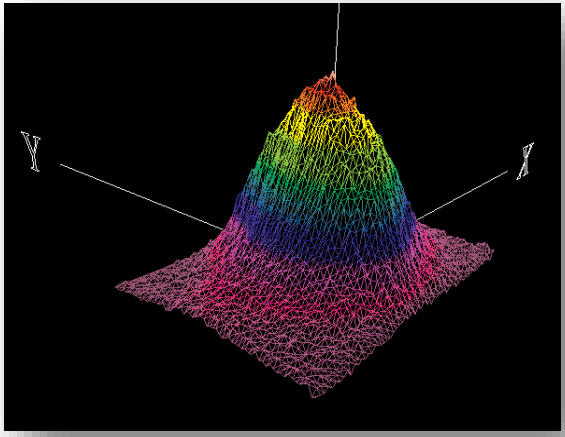


- **Spectral Range: 193 to 1700 nm**
- **WVASE32® data analysis software**
- **Measures:**
  - **Thin film thickness**
  - **Optical constants (n and k)**
  - **Spectral transmittance and reflection**
- **Focusing optics for 200 um spot size**

Imaging/ Characterization

Nd YAG Laser and Optical Parametric Oscillator OPO

Contact: Scott Williams



© Continuum Lasers

- **Continuum Pulsed Q-switched Nd YAG 8000 series Laser**
  - **Warms up to full energy in less than 5 minutes**
  - **Excellent beam quality and pointing stability**
- **Panther OPO (Optical Parametric Oscillator)**
  - **Linewidth of down to less than 1.5 cm-1**
  - **Signal energies to > 150 mJ per pulse**
  - **Complete tunability with no degeneracy gap (205 – 2550 nm)**

Laser Facility

Contact Information

Dr. Glenn Boreman, Center Director
704-687-8173, gboreman@uncc.edu

Mark Clayton, Communications/Website
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Dr. Lou Deguzman, Research Staff
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Dr. Robert Hudgins, Cleanroom Operations Manager
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Tracee Jackson, Business Manager
704-687-8106, tjacks64@uncc.edu

Scott Williams, Research Operations Manager
704-687-8126, scotwill@uncc.edu

UNCC's Optoelectronics Center has capabilities complementary to CPM in the area of **optical metrology**.

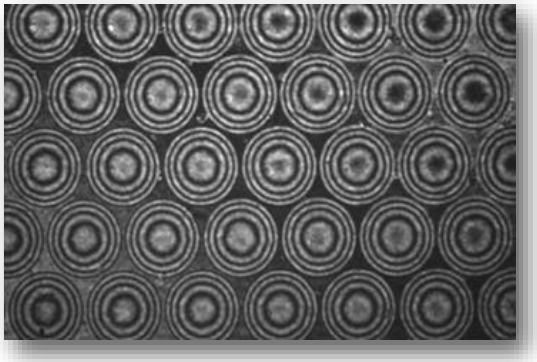
These include precise measurement of dimensional metrology for films and optical elements, measurement of optical properties of materials, and scattered light instrumentation for surface-finish assessment.

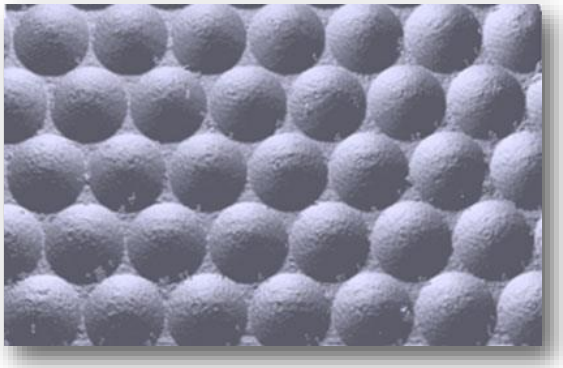
All instruments listed are available in UNCCs user facility.

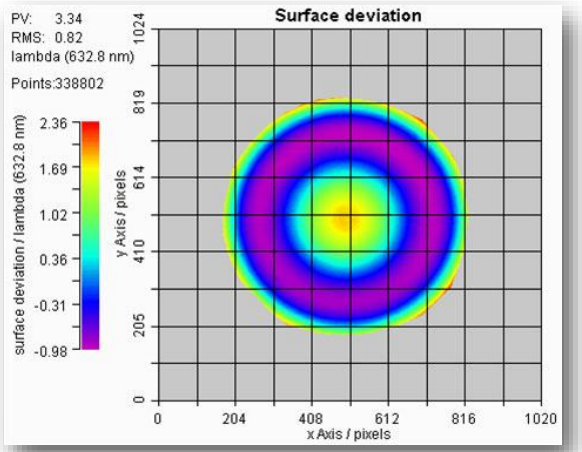
Contact Info:
Dr. Glenn Boreman, Dept. Chair & Center Director
gboreman@uncc.edu, 704 687 8173

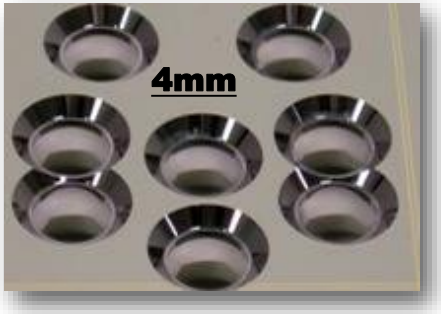
Dr. Angela Davies, Professor – Optical Metrology
adavies@uncc.edu, 704 687 8135

Micro-Interferometer





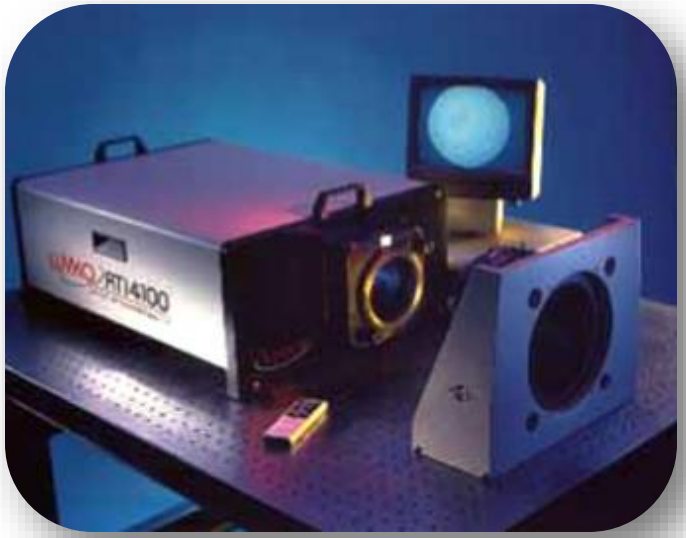




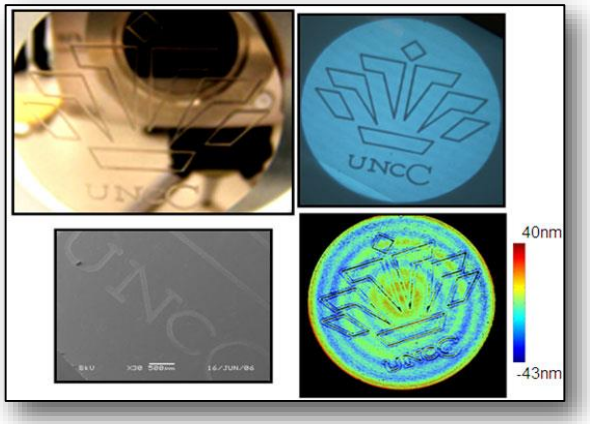
Contact: Angela Davies

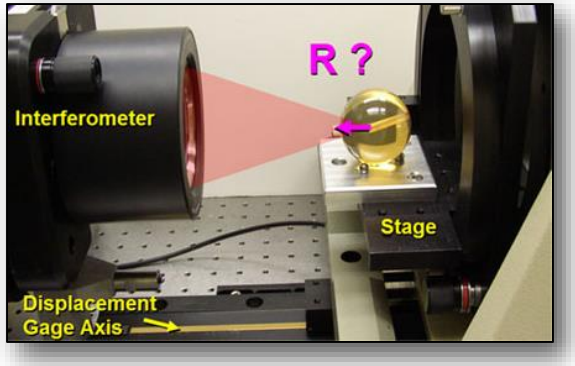
- **Optic characterization (mm-scale) 633 nm wavelength**
- **Form metrology of near flat and spherical optical-quality components (2mm – 10mm aperture)**
- **Radius of curvature (1mm – 30mm)**
- **Optical system alignment**

Phase Shifting Interferometer



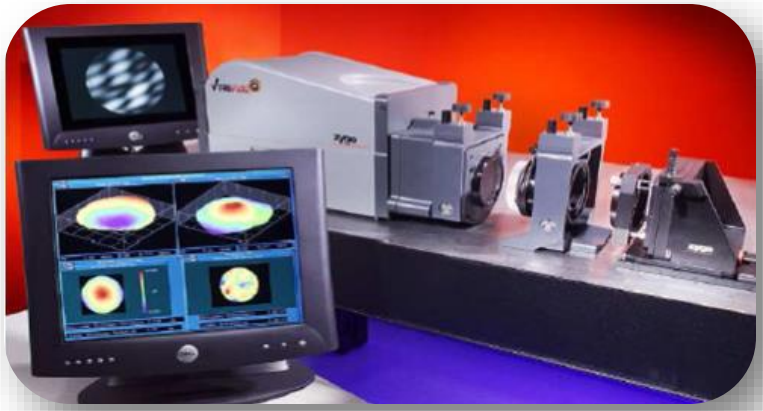
Contact: Angela Davies





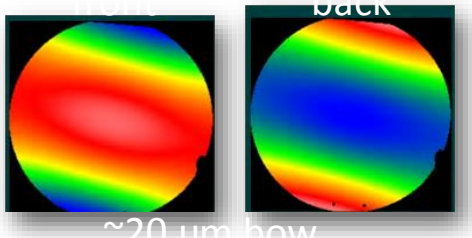
- **633 nm wavelength**
- **Form metrology of near flat and spherical optical-quality components**
- **Radius of curvature (1cm-1m)**
- **Optical system alignment**
- **4” – 0.6” aperture (flat measurements)**

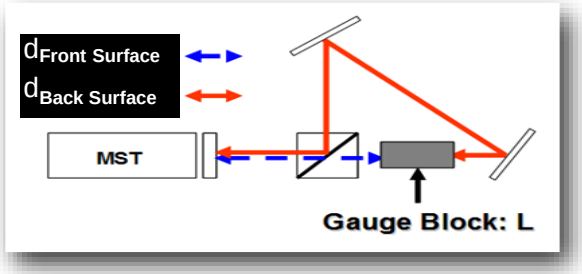
Wavelength Scanning Interferometer

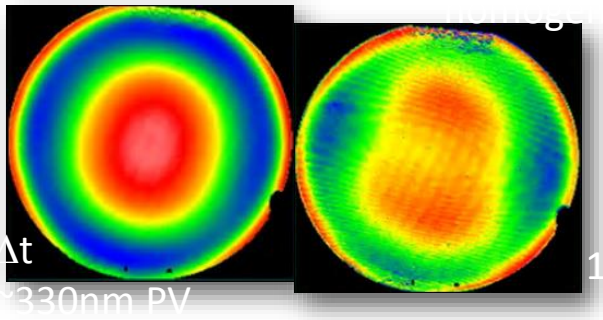


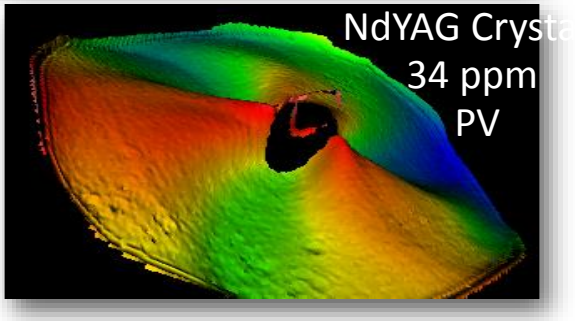
- 1550 nm wavelength
- Absolute thickness as low as 1mm
- 4”-1” aperture
- Homogeneity
- Window dimensional metrology
  - Wedge and flatness (thickness variation)

Contact: Angela Davies

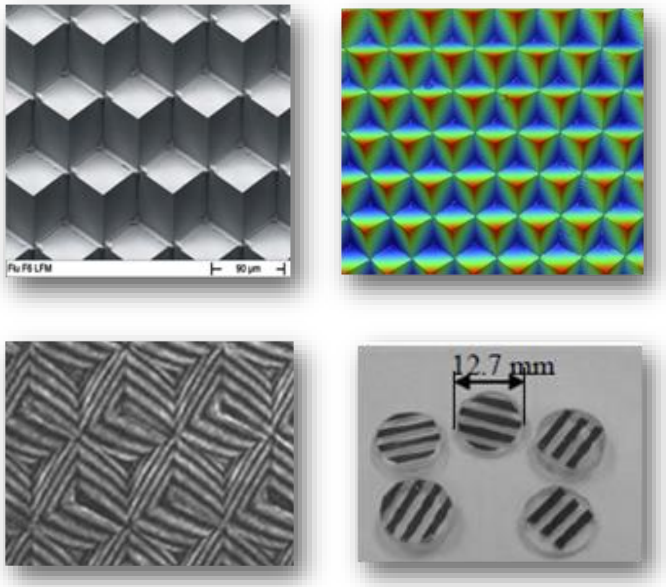








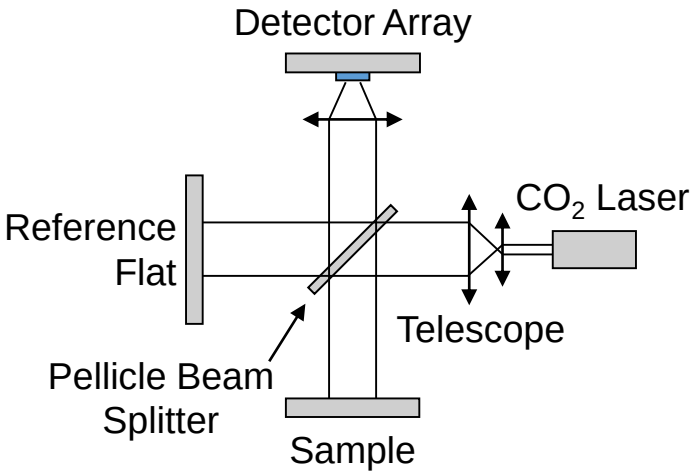
Micro-optic Reflection and Transmission Interferometer



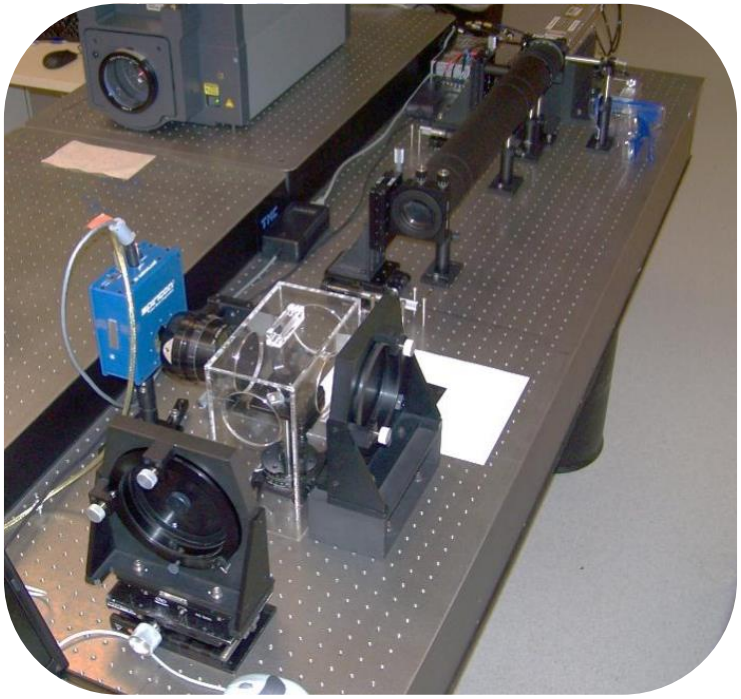
Contact: Angela Davies

- **633 nm wavelength**
- **Sub-mm Aperture Lenses**
  - **Form Error**
  - **Radius**
  - **Focal Length**
  - **Wave front Aberration**

10 micron Twyman-Green Interferometer



Contact: Glenn Boreman



- **10.6 um wavelength**
- **Testing LWIR Optics**

Tunable THz Laser

Line tunable: 300 GHz to 7 THz (1 mm to 42 um).

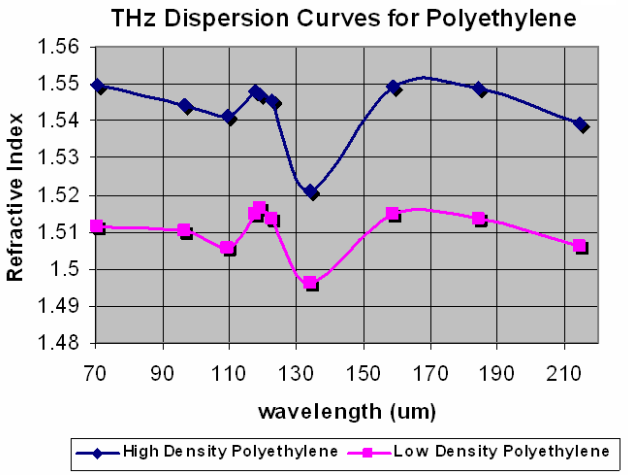
This unique source enables materials characterization, sensor characterization, component development.

Material characterization in the THz region:

Reflection, transmission, material dispersion.

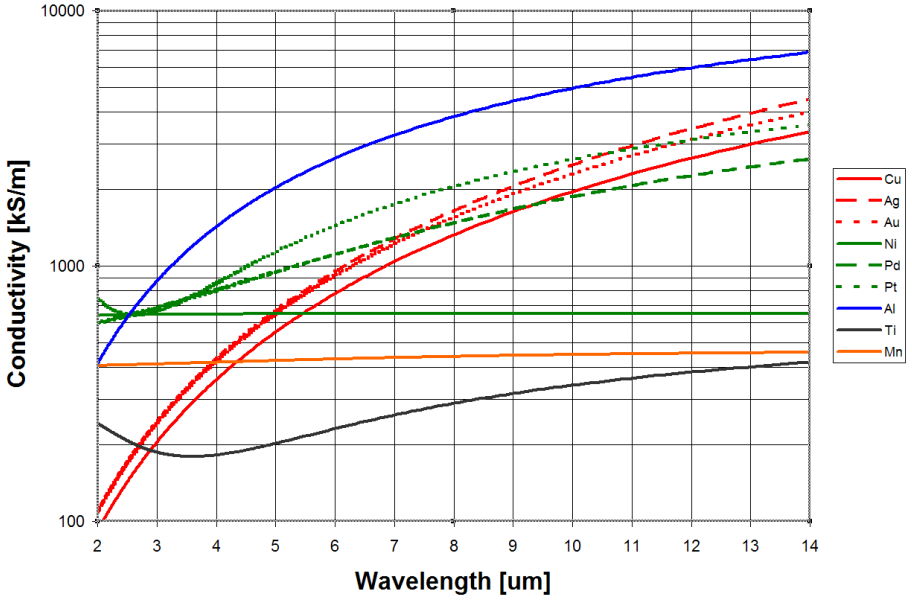
Can also characterize smoke & dust.

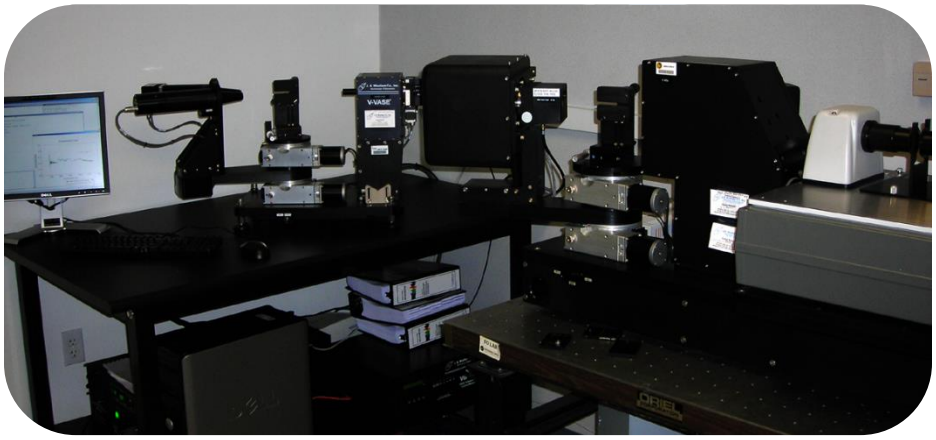
Contact: Glenn Boreman



Ellipsometers

Measure refractive index, attenuation, conductivity from 400 nm (blue end of VIS) to 40 um in the far IR (continuous coverage)





VIS/NIR Ellipsometer **IR/FIR Ellipsometer**

Contact: Glenn Boreman

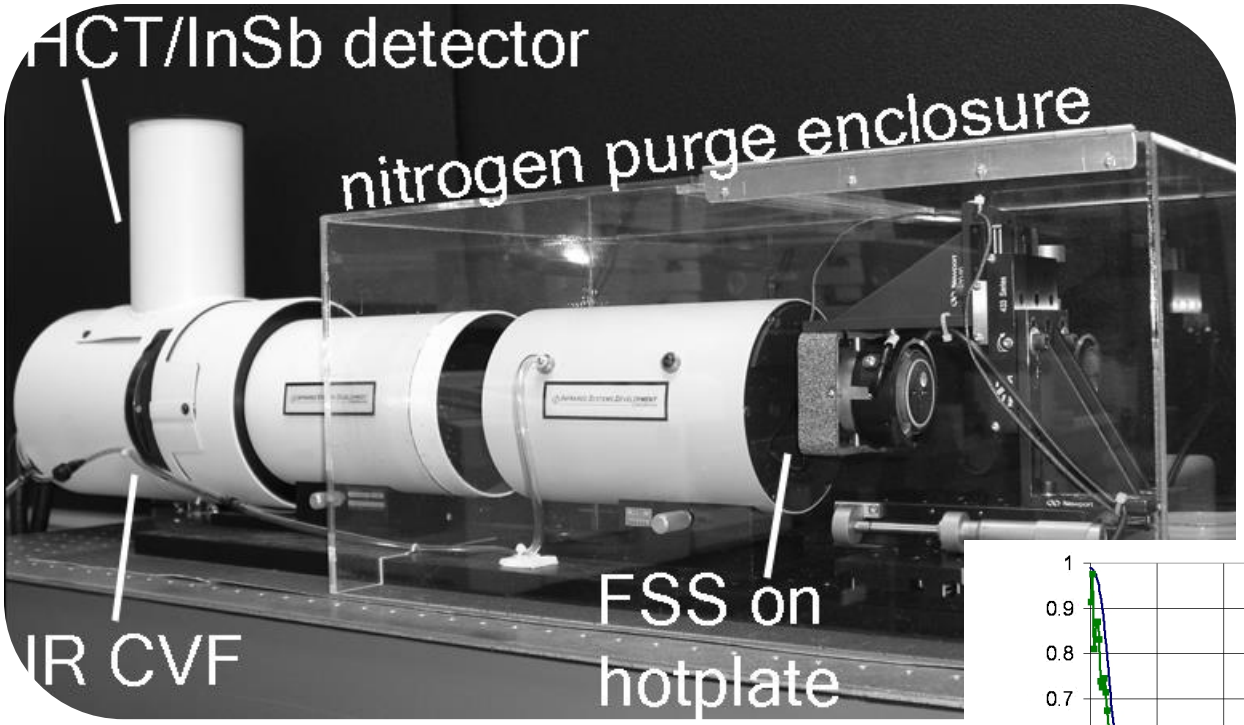
FTIR Microscope

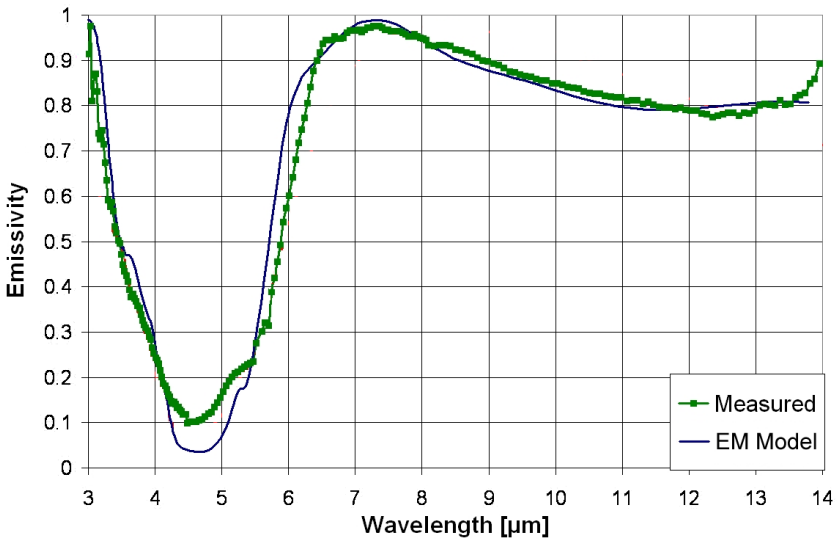
Measure reflection, transmission, absorption in SWIR, MWIR & LWIR
100 um spatial resolution

Contact: Glenn Boreman

IR Spectro-radiometer

Measure surface emissivity in MWIR & LWIR
Near-plane imaging and far-field imaging available

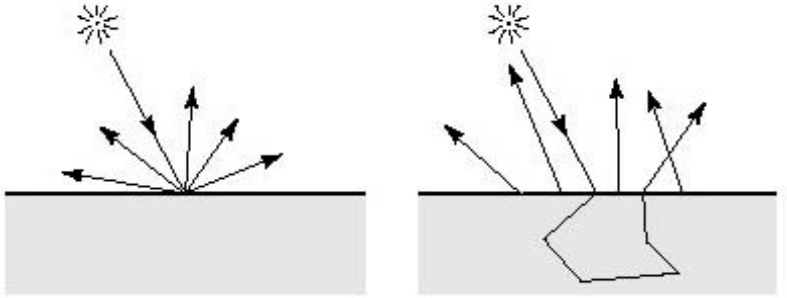




Contact: Glenn Boreman

Scatterometers

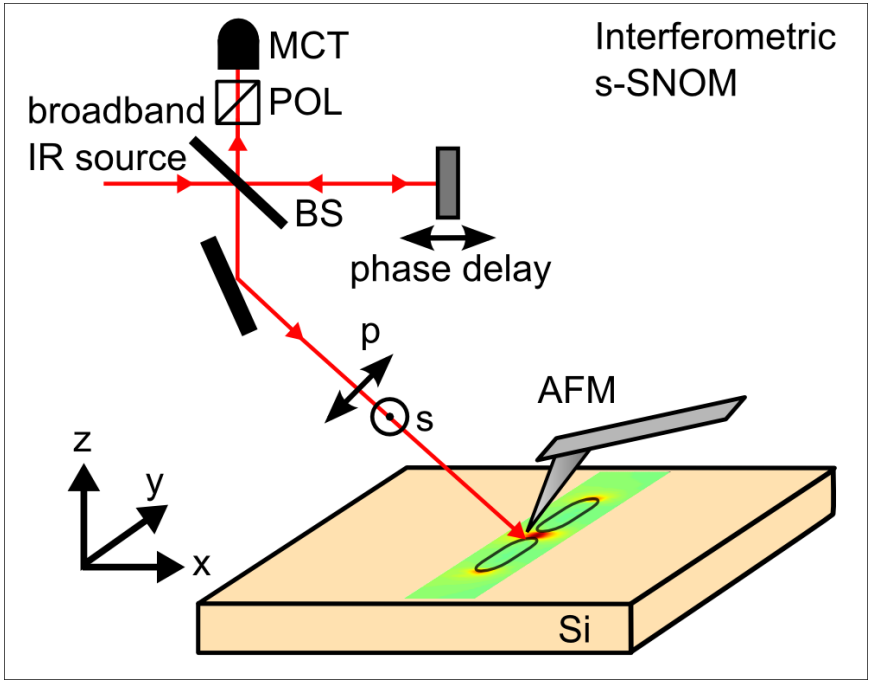
Measure surface roughness & subsurface damage using scattered light
VIS and LWIR laser, as well as spectrally resolved MWIR/LWIR

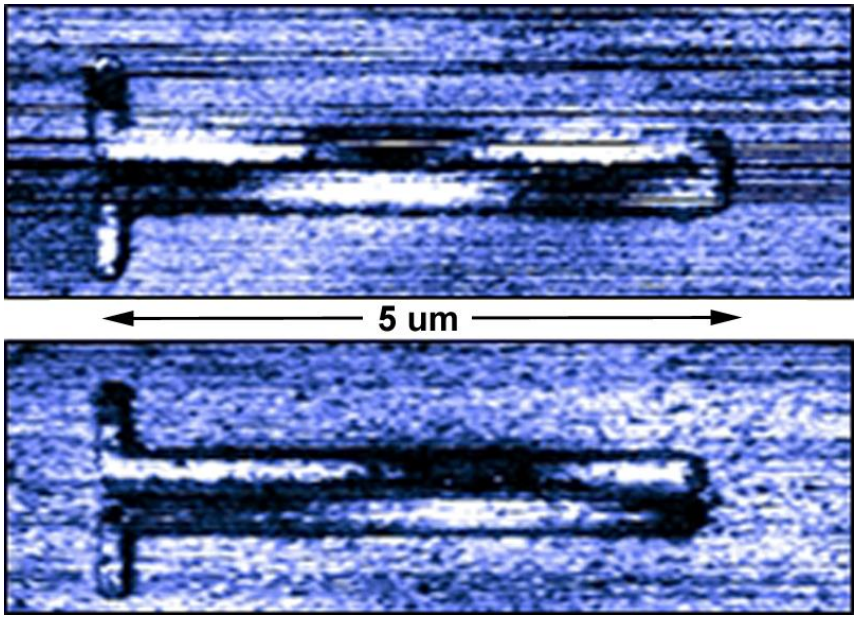


Contact: Glenn Boreman

E-field Mapper

Measure vector electric field in 3D with 20 nm spatial resolution





Contact: Glenn Boreman

Optical Communication Infrastructure Facility

Contact Info:
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Scott Williams, Research Operations Manager
Center for Optoelectronics and Optical Communications

scotwill@uncc.edu, 704 687 8126

UNC CHARLOTTE

Contact:
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704-687-8126
scotwill@uncc.edu

Fiber Optic Connector Assembly

Capabilities

- Connector assembly of most major connectors and manufacturers including.
  - FC, FC/Angle, SC, SC/Angle, ST, LC, MU, MTRJ, FDDI, ESCON, DIN, Biconic, SMA
- Assemblies done on most size fiber including large core.
  - 250um coated
  - 900um coated
  - 1.6mm Jacketed
  - 2.0mm Jacketed
  - 3.0mm Jacketed
- Assembles on large count cables.
  - Loose Tube
  - Distribution
  - Breakout

UNC CHARLOTTE

Contact:
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scotwill@uncc.edu

Capabilities

- Connector end face inspection at 400x for most connector styles
- Connector testing for most connector style.
  - (IL) Insertion Loss
  - (RL) Return Loss
- End Face Geometry checked with Norland Connect-Check 6000
  - Apex Offset
  - Fiber Protrusion/Undercut
  - Radius of Curvature
  - Angle
- Full reporting Capabilities

Fiber Optic Connector Testing

UNC CHARLOTTE

Contact:
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704-687-8126
scotwill@uncc.edu

Technical Data

Current Connector Types	MT
Connector types that can be added	FC, LC, LC/Angle, LX.5, MT/Angle, MTRJ, MTRJ/Angle, MU, SC, SC/Angle, SMA, Ferrule Only
Pressure Type	Pneumatic
Platen Size	5in.

Domaille Engineering
Optical Fiber Polishing Machine
Model: HDC-4000

UNC CHARLOTTE

Seiko Instruments
Optical Fiber Polishing Machine
Model: OFL-12

Contact:
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704-687-8126
scotwill@uncc.edu

Technical Data

Current Connector Types	FC, FC/Angle
Connector types that can be added	LC, LC/Angle, MU, MU/Angle, ST, SC, SC/Angle, E2000, E2000/Angle, Ferrule Only, Ferrule only/Angle
Pressure Type	Spring
Platen Size	4in.

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Ultra Tec
Ultrapol Fiber Lens Polisher
Model: 6380.1

Contact:
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704-687-8126
scotwill@uncc.edu

Technical Data

End Shapes	Cone, Chisel, Bevels
Angle Range	20 to 180 degrees
Angular Accuracy	0.1 degrees
Fiber Diameter	80 & 125um
Platen Size	5in.

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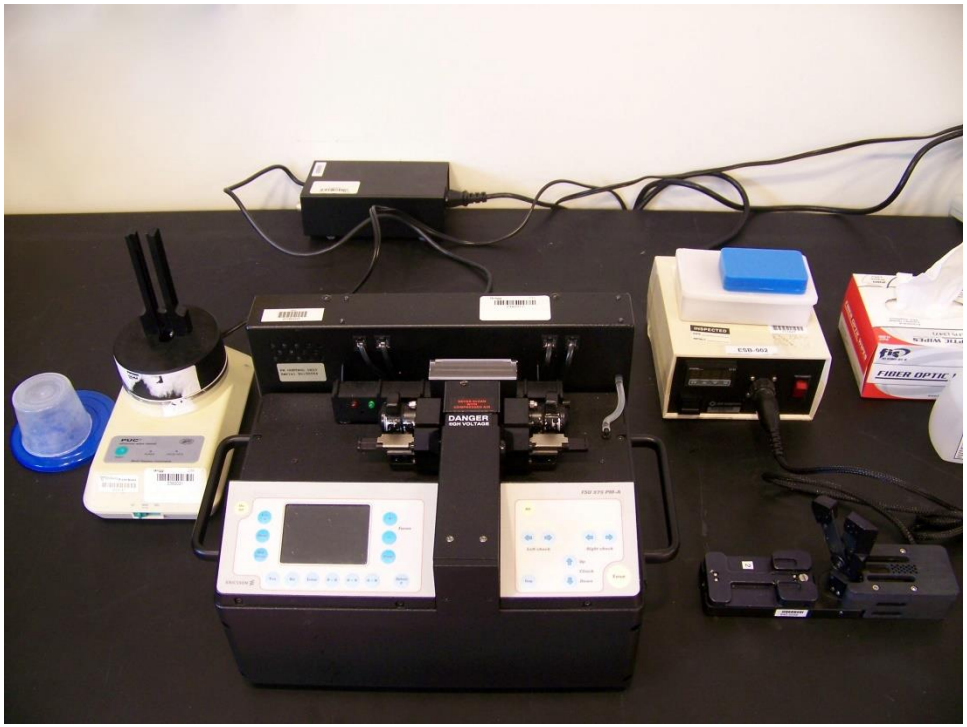

Contact:
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scotwill@uncc.edu

Technical Data

Fibers	Single-mode, multimode, dispersion-shifted, Polarization maintaining, erbium
Typical splice losses	0.02 dB SM fibers

Ericsson Fusion Splicer
Model: FSU 975 PM-A

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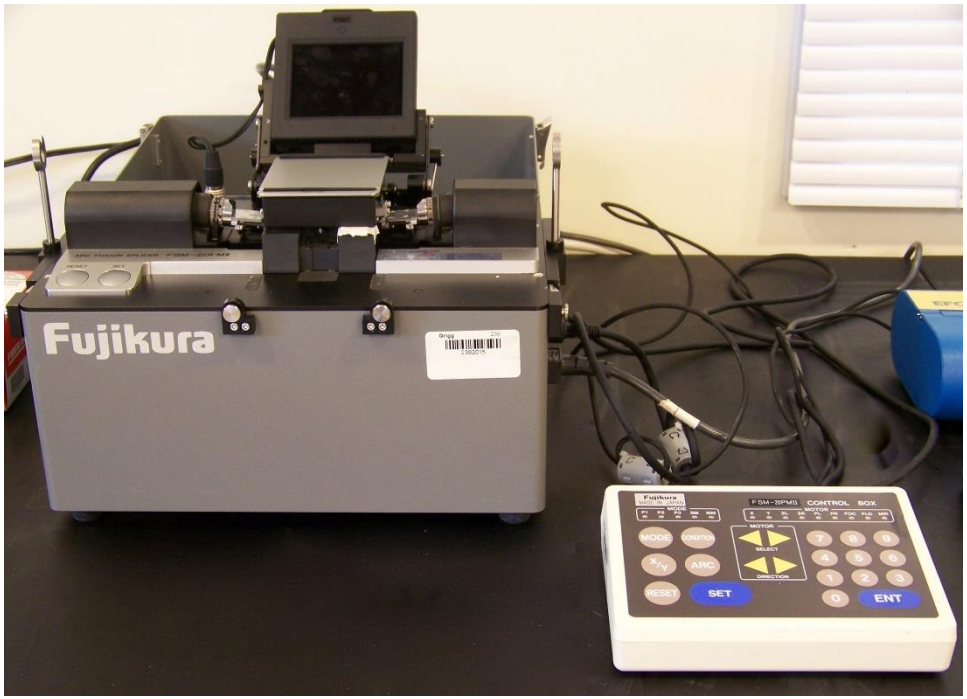

Fujikura Fusion Splicer
Model: FSM-20PMII

Contact:
Scott Williams
704-687-8126
scotwill@uncc.edu

Technical Data

Fibers	Single-mode, multimode, dispersion-shifted, Polarization maintaining,
Typical splice losses	0.07dB PM fibers 0.03dB SM fibers 0.02dB MM fibers
Typical Extinction ratio	>30dB

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Contact:
Scott Williams
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Technical Data

Fibers	Single-mode, Multimode, Dispersion-shifted, Non-zero dispersion shifted, Cut-off shifted, Erbium doped
Typical splice losses	0.02dB SM fibers 0.01dB MM fibers 0.04dB NZDS fibers
Typical return loss	>60dB

Fujikura Fusion Splicer
Model: FSM-40S

UNC CHARLOTTE

Luna Technologies
Optical Backscatter Reflectometer
Model: OBR

Luna Technologies Screen Shot

Contact:
Scott Williams
704-687-8126
scotwill@uncc.edu

Measurement Highlights:

- High resolution OFDR - Resolve individual features with spatial resolution down to 10 microns.
- High sensitivity - 70 dB of dynamic range and -130 dB sensitivity.
- Long range - Measure up to 2000 meters in length with a single connection, single scan.
- Single Connection IL and RL - Measure insertion and return loss in a single scan.
- Locate loss events - Monitor backscatter levels to isolate losses due to bends, crimps, bad splices.
- “Look inside” devices - High resolution and sensitivity enable inspection of individual components within a subsystem.
- Polarization Tracking - Track changes in the state-of-polarization as light propagates through an optical network.
- Intuitive graphical interface - All key data and graphs in a simple, easy to use interface.
- Distributed sensing - Use standard optical fiber to monitor the changes in temperature and strain

Wavelength Range 1530nm to 1620nm

UNC CHARLOTTE

Contact:
Scott Williams
704-687-8126
scotwill@uncc.edu

Luna Technologies
Optical Vector Analyzer
Model: OVA ST

Measurement Highlights:
The OVA simultaneously performs these optical component characterizations every second:

- Insertion Loss (IL)
- Return Loss (RL)
- Polarization Dependent Loss (PDL)
- Phase Response
- Group Delay (GD)
- Chromatic Dispersion (CD)
- Polarization Mode Dispersion (PMD) / Second Order PMD
- Min/Max Loss due to Polarization
- Impulse Response
- Jones Matrix Elements
- Phase Ripple - Linear and Quadratic

Wavelength Range 1530nm to 1620nm

UNC CHARLOTTE

Contact:
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704-687-8126
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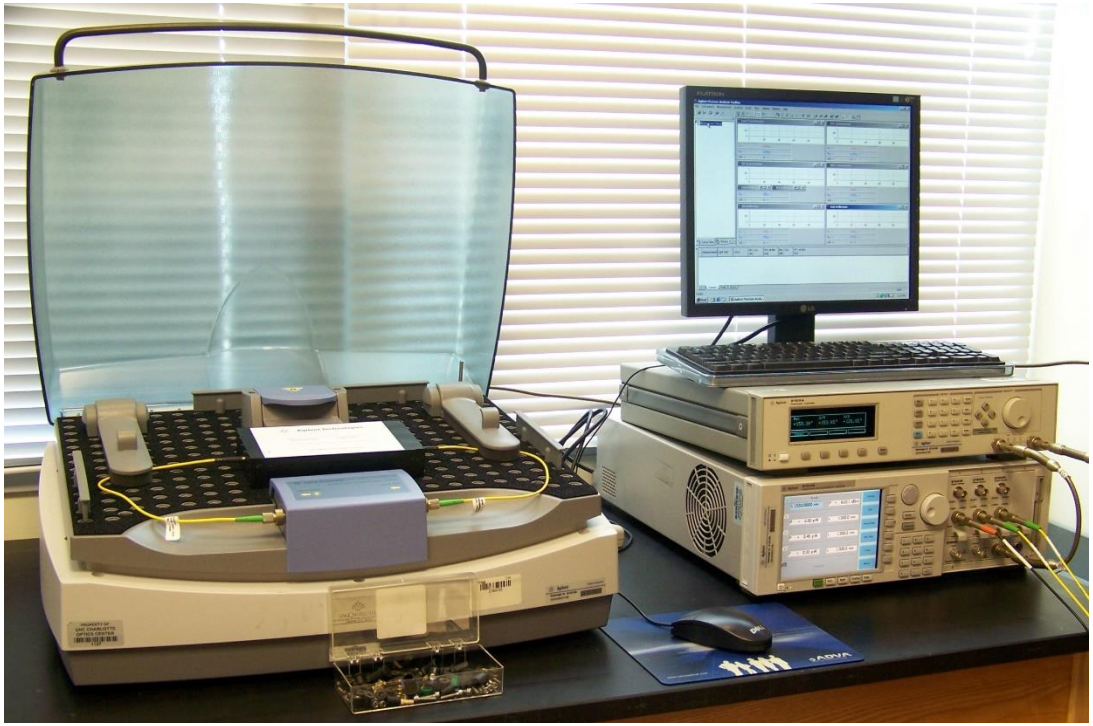

Measurement Highlights:

The Agilent 81910A enables exhaustive analysis of advanced photonic devices, covering all physical properties relevant to DWDM components in a single solution:

Simultaneous all-optical measurement of:

- (IL) Insertion loss
- (RL) Return Loss
- (PDL) Polarization Dependent Loss
- (GD) Group Delay
- (DGD) Differential Group Delay
- (CD) Chromatic Dispersion
- (PMD) Polarization Mode Dispersion

Direct access to Mueller Matrix and Jones Matrix for deepest insight into a device's transmission and reflection properties

Wavelength Range 1530nm to 1620nm

Agilent
All Parameter Analyzer
Model: 81910A

UNC CHARLOTTE

Contact:
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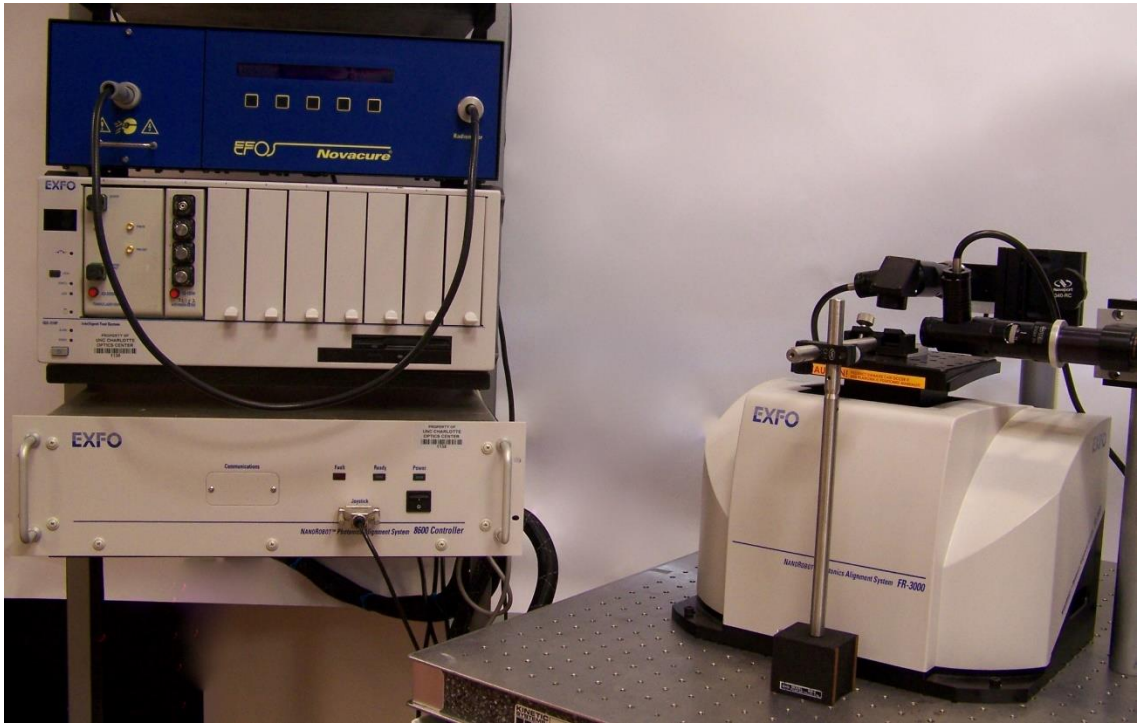
scotwill@uncc.edu



Exfo/Burleigh
Nano Robot System
Model: FR3000

Including

EFOS
UV Curing System
Model: Novacure

Features and Benefits

Nano Robot System

- Ultrahigh performance in six degrees of freedom for the most demanding photonics applications
- Robust design suitable for the manufacturing floor as well as labs and clean rooms
- High stiffness and stability minimize drift during bonding and reduce effects of environmental vibration and temperature
- Independent axis control with full range of motion in six degrees of freedom eliminates detrimental translation and cross- coupling effects
- Incorporates patented INCHWORM® motor technology to deliver high 0.1-nm resolution and long travel

Novacure

Typical power output with a standard filter at 320-500nm: 23,400 mW/cm2

UNC CHARLOTTE

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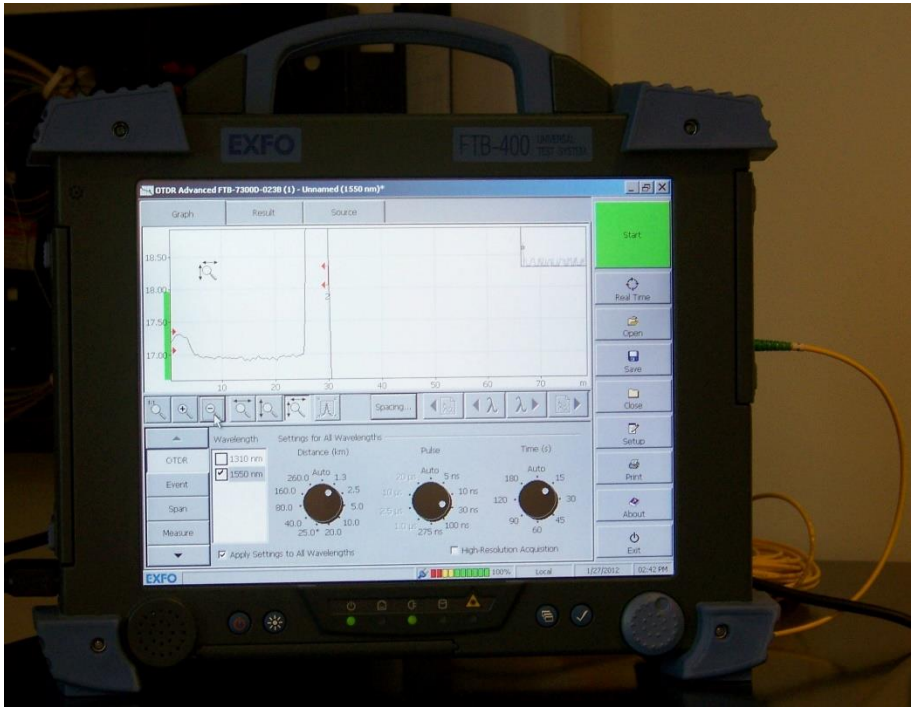
704-687-8126
scotwill@uncc.edu



Exfo
Optical Time Dominion Reflectometer
Model: FTB400

Features and Benefits

- Modular 2 bay design.
- Touch screen for ease of use.
- Full color display
- Large internal storage with USB ports to retrieve data.

Current Module:
OTDR 1310nm and 1550nm

Expansion Modules Available

- Over 25 OTDR models covering all network testing applications, from core to access.
- Over 11 OLTS models for testing optical return loss (ORL) and insertion loss (IL).
- CD and PMD analyzer.
- OSA.
- SONET/SDH analyzers (up to 10 Gbit/s)
- Next-generation SONET/SDH analyzers.
- DSn/PDH analyzers.
- Ethernet analyzers (up to 10 Gbit/s).
- Fiber Channel analyzers.
- Switch module.
- Modular pulse-suppressor boxes (single mode and multimode)

UNC CHARLOTTE

Contact:
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scotwill@uncc.edu

Capabilities

- Multiple Tunable Lasers covering from the S-Band through the C & L Bands.
- Wavelength Meters
- Power Meters
- Optical Spectrum Analyzers
- Optical Stages
- Motion Controllers
- Polarization Controllers
- Laser Drivers
- Free space optical meters and heads
- Optical Switches
- Erbium Doped Fiber Amplifiers
- Microscopes

Bench Top Equipment and
Custom Designed Test Arrangements

UNC CHARLOTTE

Contact:
Scott Williams
704-687-8126
scotwill@uncc.edu

Continuum
Optical Parametric Oscillator
Model: Panther

Continuum
Nd:Yag Laser
Model: Precision II 8000

Capabilities

- Tunable wavelengths from 205nm to 2550nm
- a line width of down to less than 1.5 cm-1Power Meters

UNC CHARLOTTE

Contact:
Scott Williams
704-687-8126
scotwill@uncc.edu

Capabilities

- 1-15Hz adjustable repetition rates
- Up to 100mJ at 15Hz
- 1064, 532, 355, and 266nm

Continuum
Nd:Yag Laser
Model: MiniLite II

UNC CHARLOTTE