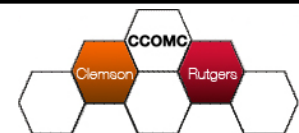


# Overview of CCOMC Spring 2019

Director of CCOMC, Rutgers University: Richard Haber



Ceramic, Composite and Optical Materials Center  
*An NSF Industry/University Cooperative Research Center*



Ceramic, Composite, and  
Optical Materials Center

# Ceramic, Composite and Optical Materials Center, CCOMC

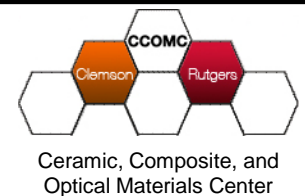
- NSF's Oldest Active IUCRC – 37 years old
- Rutgers –Clemson University provide complementary expertise emphasizing synthesis, processing and materials design
- New Rutgers Facilities include:
  - New Centorr Arc Melter and New Arc Cast Arc Melter, Netzsch Horizontal Mill
  - Keyence Laser Scanning confocal microscope
  - TA DTA/TGA couples with mass spec, FTIR-Acoustic/microscope
  - Admatec DLP AM Printer (NEW AUGUST 2019), TCW Bench tape caster, Catalina Microfab, Hyrel Direct Write AM (MAY 2019)
  - New macrohardness, BET, Hg Porosimetry
  - 100 Ton Thermal Hot Press (JUNE 2019)
  - SOON: Zeiss Gemini FESEM w/ Cryo (JULY 2019) and WDS, Netzsch Hi Temp Thermal Lab (SEPTEMBER 2019)
- The next meeting will at Daytona on Thursday, January 30, 2020

# New User Facilities

*Available to Center members at Internal Rate*



Ceramic, Composite and Optical Materials Center  
*An NSF Industry/University Cooperative Research Center*



# CCOMC Characterization Facilities

## Microscopy and XRD



**Zeiss Sigma FESEM with Oxford X-Max EDS and Oxford Nordlys EBSD**



**Panalytical Xpert XRD**



**Keyence VHX 500 Digital Microscope**



**Hitachi LN2 Cooled Ion Mill**



**Sample preparation from Buehler Ecomet Auto Polishers (left); SPI Plasma Etcher (right)**



# CCOMC Characterization Facilities Microscopy and XRD

**NEW 2019**



**Zeiss Gemina FESEM with Oxford X-Max EDS and  
Oxford WDS, Quorum Cryo Stage**

**NEW 2019**



**Keyence VK-X1000 Laser Scanning  
Confocal Digital Microscope**

# CCOMC Characterization Facilities

## Mechanical Property Analysis



**Micro Materials Vantage  
Nano/Microindentation  
System and Nano-  
impact System**



**Wilson Automated  
Hardness Tester**

***NEW 2018***



**Instron 5980 Universal  
Tester**

***NEW 2018***

# CCOMC Characterization Facilities

## Thermal Property Analysis



**Netsch 2400C DTA/TGA**

***NEW 2019***



**Netsch 2800C Dilatometer**

***NEW 2019***

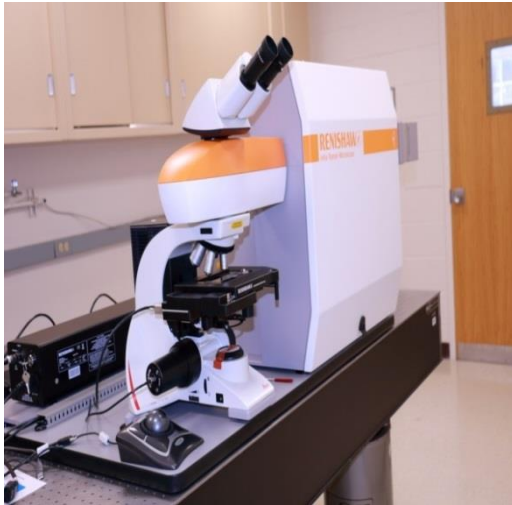


**Netsch 2400C Laser Flash**

***NEW 2019***



# CCOMC Characterization Facilities Spectroscopy Laboratory



Renishaw In Via Raman, 3  
laser 535, 635, 839nm, DAC,  
RDAC, Hi Temp



Madison Galaxy  
FTIR

## **NEW 2018**

### Diacell® $\mu$ ScopeDAC-HT(G)



- Gas Membrane-Driven High-Temp. Microscope Cell
- High pressures (up to 50 Gpa)
- High temperatures (up to 600 °C)



### Diacell® ShearDAC

- Diamond anvil cell ideal for performing experiments with simultaneous shear and static high-pressure up to above 50 GPa



# CCOMC Characterization Facilities Chemical and Particle Analyses



Metrohm Titrando Auto Titrator  
for total Boron content



Micromeritics Autopore  
V Hg Porosimeter



Micromeritics 3Flex BET  
Surface Area Analyzer



TA Q600 TGA/DSC with SPI  
200amu mass spec



Leco CS 230 Carbon/Sulfur Analyzer (left); Leco TC600  
Oxygen/Nitrogen Analyzer (right)



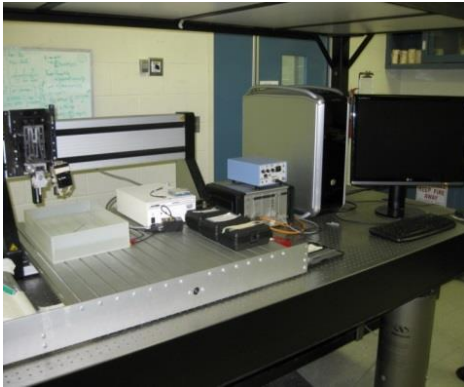
Malvern ZetaSizer  
Nano S



Malvern Mastersizer 2000  
Particle Size Analyzer

# CCOMC Characterization Facilities

## Process Characterization and Support



Rutgers UT NDE – for both TOF and attenuation Measurements from 0.1 to 150 MHz



Olympus Omniscan Phased Array UT NDE



Agilent Leak Detector



Bohlin Rosand 2000 Capillary Rheometer



Bohlin Gemini HR Rheometer And Kinexus Ultra Rheometer



Haake Rheocord 9000 Torque Rheometer



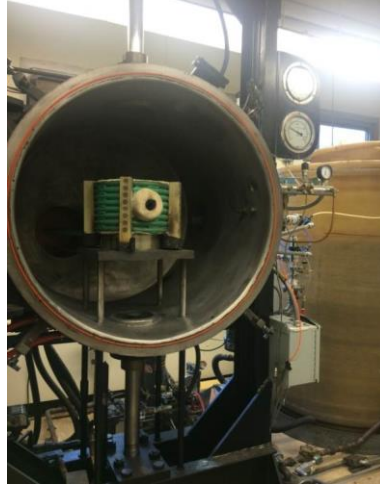
Micromeritics Autopyc II He Pycnometer

# CCOMC Processing Facilities

## High Temperature Furnace Lab



AVS Vacuum Furnace – 2000C



Centorr/VI 20T  
Hot press – 2200C



Thermal Technologies 10T Spark  
Plasma Sintering



Depth of the Earth 3GPa  
1800C Pressure Furnace



# CCOMC Processing Facilities

## High Temperature Furnace Lab



Thermal Technologies 2600C  
Graphite Furnace

**NEW 2018**



Thermal Technologies 2600C, 100 Ton Hot Press

**NEW 2019**

# CCOMC Processing Facilities

## Green Body Processing



**Beckman Coulter Allegra Centrifuge**



**Autoclave Engineering 20T Isostatic Press**



**Oxygen Controlled Glove Boxes**

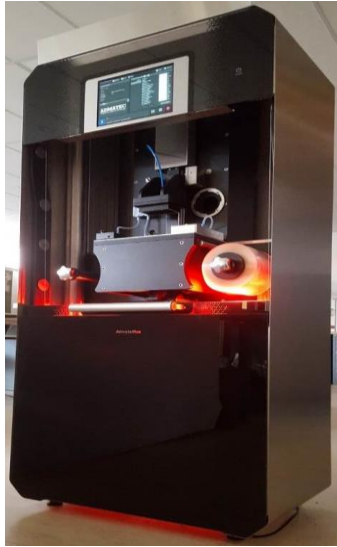


**Szegari 4 liter Attrition Mill**



**Carver 10T Uniaxial Platen Presses**

# CCOMC Processing Facilities Additive Manufacturing



Admaflex 130 DLP printer

**NEW 2018**



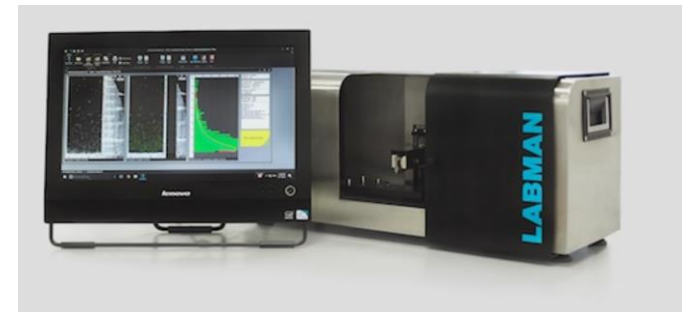
GPD Global Microfab

**NEW 2019**



FormLab 2, Printer, Wash and Cure

**NEW 2019**



TIDAS Automated Hegman Gauge

**NEW 2018**



# CCOMC Processing Facilities Green Body Processing



**Niro Atomizer  
Spray Drier**



**Buchi B290  
Spray Dryer**



**Resodyne Acoustic Mixer**



**NEW 2018**

**Torrey Hills 3 Roll Mixer, both steel and  
alumina rolls**



**Eirich Lab Mixer**



**NEW 2018**

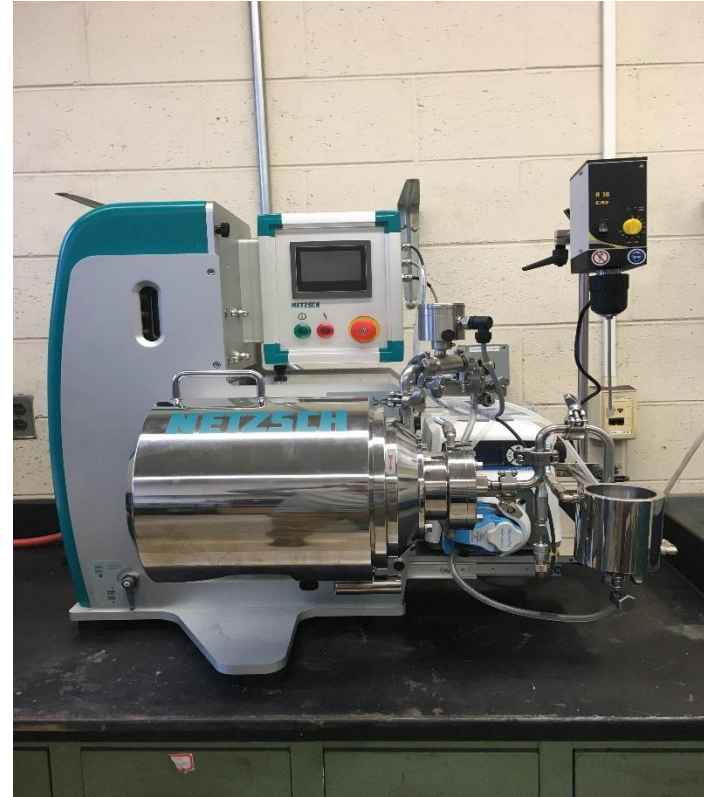
**Speed Mixer Centrifugal Mixer**

# CCOMC Processing Facilities Green Body Processing



Mistler 15' x 16" Tape Caster

**NEW 2018**



Netzsch Mini Cer Horizontal Bead Mill

**NEW 2018**

# Carbothermal Reduction Laboratory



**Yamato Pan Drier**



**Unique Pereny  
Atmosphere  
controlled rotary  
calciner – 1000C**



**Assorted CM Air Furnaces,  
1650C (8"x8" and 12"x12")**



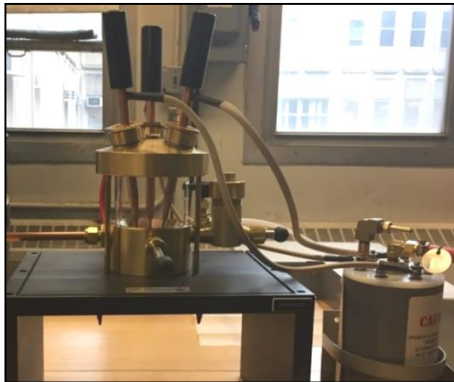
# CCOMC Processing Facilities

## Arc Melting and Rapid Carbothermal Synthesis

**NEW 2018**



**Arc Cast 200 Laboratory Arc Melter**



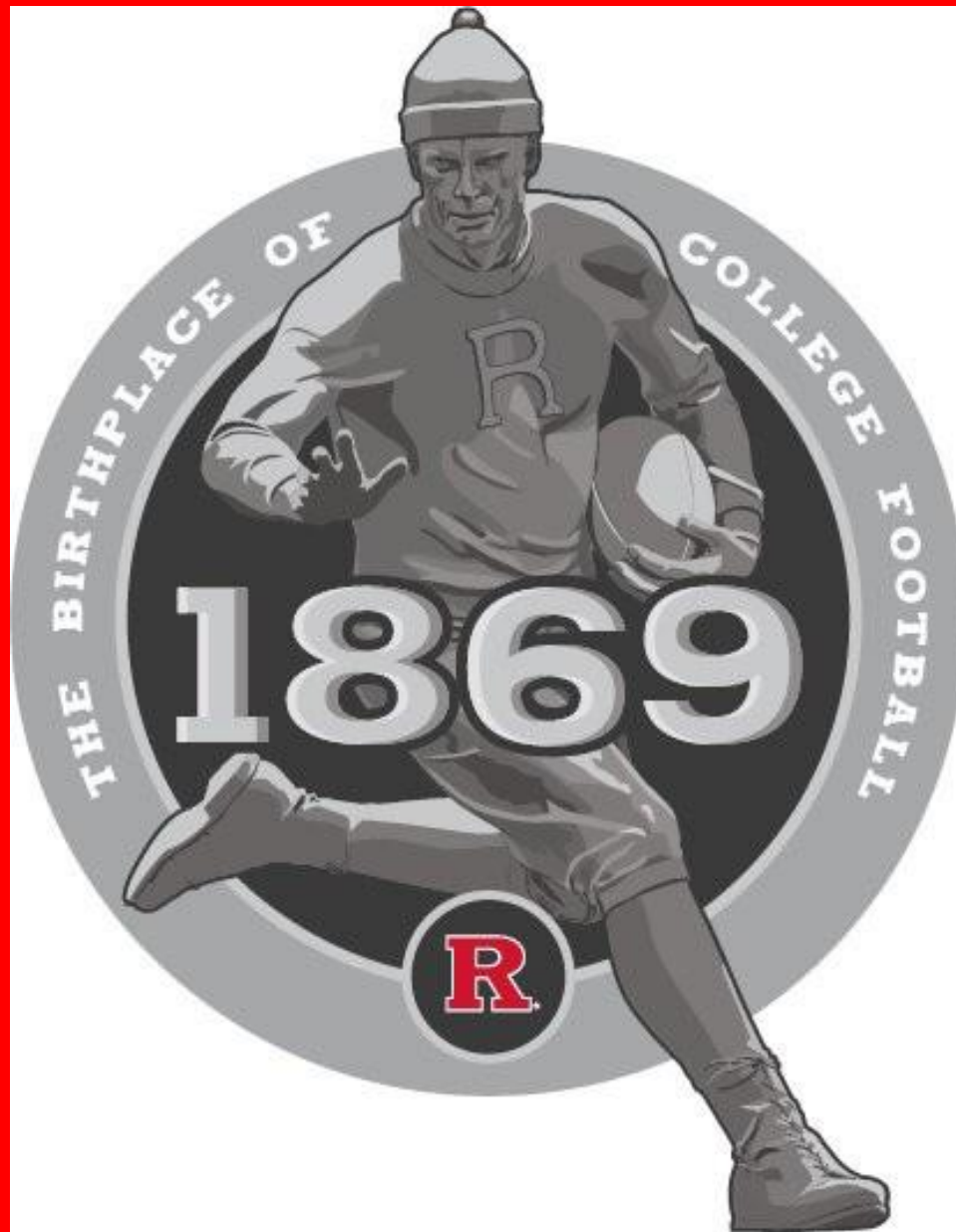
**Centorr Tri Arc Arc Melter**



**Small RCR Reactor (left) 10gram/2000C**



**Large RCR Reactor (right) 1Kg/2100C**



**Big Ten Champions 2020**