

School of Polymer Science and Engineering

EQUIPMENT AND INSTRUMENTATION LIST

The University of Southern Mississippi School of Polymer Science and Engineering is housed in a 106,000 square foot research facility with comprehensive polymer synthesis, analysis, characterization and processing capabilities. Available equipment and facilities include:

3D PRINTERS

- Formlabs Form 2
- Lulzbot Taz 6
- Lulzbot Mini
- Autodesk Ember (x2)
- Ultimaker S5
- DeltaMaker 2T Large Format

BARRIER PROPERTIES ANALYSIS

- Mocon Ox-Tran Model 2/21 Oxygen Permeability
- Mocon Aromotron Solvent Vapor Transport Unit
- Mocon Permatran-W 3/31 Water Vapor Permeability
- Mocon Permatran-W 3/33 Water Vapor Permeability

CHROMATOGRAPHY

- Agilent PL-GPC 220 High Temperature GPC System
- Agilent/Varian 500 MS System
 - LC/MS/MS and MSⁿ capability
 - Electrospray ionization detector (ESI)
 - Atmospheric pressure chemical ionization detector (APCI)
 - Prostar 420 Autosampler
- Agilent/Polymer Laboratories PL-GPC50 Plus High Resolution, Integrated GPC System
 - PL-AS RT autosampler
 - RI Detector
 - PL-BV 400RT viscometer
 - PL-LS 45°/90° dual angle laser light scattering detector
 - Variable wavelength UV detector
- Waters 2690 HPLC/GPC analysis system
- Spectra/Chrome preparative LC
- Dual GPC size exclusion systems
 - *Aqueous Ultrahydrogel columns*
 - *THF 3 PL-gel columns*
 - *Polymer Labs Caliber 5.1 software*
- Hewlett Packard capillary HPLC

- 1050 pump, 1047A RI, 3396 integrator, cyano capillary column
- Spectra Physics System reverse phase HPLC
- Hewlett Packard 6890 GC
 - MSD 6890 Mass Selective Detector
 - 6890 auto sampler
 - Windows NT operating system with enhanced chemstation software
- Pervaporation unit, liquid separations using films
- Linde Gas Permeation device
- Agilent 1260 Infinity II system
 - Wyatt Technology Dawn Heleos-II
 - Wyatt Technology Optilab T-rEX RI Detector
- Acquinity System
 - Acquinity PDA TS Detector
 - Acquinity ELS Detector
 - Acquinity RI Detector
- Teledyne ISCO CombiFlash NEXTGEN 300+ (small molecule flash chromatographer)

COMPOSITES CENTER

- American Autoclave – custom built autoclave 4' x 2', 500°F, 200psi
- Heatcon debulking vacuum table 4' x 4'
- Century Design CD-1510 12" wide lab scale drum Winder
- Trilion Optical Test Systems ARAMIS 3D HR, 3D image correlation system for strain mapping of composite failure events
- Gnomix PVT High Pressure Dilatometer for analysis of composite properties associated with the coefficient of volume thermal expansion and shrinkage upon curing
- Mitsubishi Suprema DX1200 Waterjet CAD cutting system
- Myers Engineering tri-shaft high viscosity mixers with full PLC statistical process control, vacuum system, 3 gal and 5 gal capacity, oil heat/cool recirculation
- WAECO 12" (30.4 cm) HMUD Prepreg Machine, designed to impregnate unidirectional fibers with hot melt resins, through a combination of consolidation and compaction at elevated processing temperatures
- MasterCam® CNC CAD/CAM design software
- ASC Econoclave® Model # EC-3X5-200P800F-3S3P6T
- Composite Alliance Corp. Techni-Modul Resin Transfer Molding (RTM) Work Station
- Precision Quincy programmable post cure oven, maximum operating temperature of 800°F, interior dimensions of 72" x 72" x 60"
- Dantec Dynamics Q-800 shearography imaging system
- Gerber DCS 1500 static cutting system
- Extec Labcut 5000 precision saw

COATINGS LABORATORY

- Q-Fog salt spray chamber
- QUV accelerated weathering testers
- Q-Sun Xenon Arc Test Chamber, Model Xe-3-HS
- Prohesion chamber
- Gardner impact tester
- Gardner minimum film forming temperature bar 90
- Fusion systems EPIQ6000 ultraviolet curing apparatus
- Gardco statistical Novogloss gloss meter
- Thickness gauges
 - *Dial*
 - *Minitest 4000*
 - *Fisher permascope*
 - *Digital micrometer*
 - *PosiTector 6000-FN3*
 - *PosiTector 100 ultra-sonic multi-surface film*
- DeFelsko PosiTest® digital pull-off adhesion tester
- Draw down bars
- Shar Incorporated high-speed mixer
- Myers Engineering high-speed mixer
- Kinetic Dispersion Corporation Kady Mill
- SpeedMixer™ dual asymmetric centrifugal laboratory mixer
 - DAC 100 and DAC 800 models
- Thomas Scientific Shell Labs inert atmosphere oven
- Teledyne taber abrader
- Paul Gardner dry time recorder
- Sward rocker hardness tester
- BYK-Gardner micro tri gloss meter
- Gardner EZ viscosity cups
- Gardco/Hoffman SAM tester
- Norton ball mill
- Microfluidics microfluidizer
- Gardner conical mandrel bend tester
- Gardner mandrel bend tester
- Ford viscosity cups
- Contact angle tester
- Hegman gauge
- Pencil scratch hardness tester
- Crosshatch adhesion tester
- Weight per gallon cups
- Gardner glossgard system
- PTC instrument durometers
- Gardner bubble viscometer
- HVLP spray guns

- Forced air ventilation paint spray booth (10'x8'x8')
- Shar D-38 SPZ 30 gallon mixing system
- BYK-Gardner color guide 45/0° hand held colorimeter with computer interface
- BYK-Gardner handheld color spectrophotometer
- Little Joe one-color proofing press
- Anthony laboratory three-roll mill
- BYK Gardner Byko Spectra 5 light booth
- BYK Gardner Haze gloss system
- Gardco sagmeter medium range

EMULSION POLYMERIZATION

- Dow DCU controller, Camile 2000
- Dual Masterflex 7518-10 console drive pumps
- Dual KD scientific RS 232, dual-syringe pumps
- Fisher isotemp 730 immersion circulator
- Mettler RC1e reaction calorimeter

INK PROCESSING EQUIPMENT

- Parker Print-surf model M590 measuring 0.6 to 14.0 microns with automatic statistical analysis, data printer, built in calibration routines, test and calibration set, porosity test head
- TMI ink rub tester with three speed settings
- TMI digital bench micrometer
- TMI K303 Multicoater with gravure laminating head, engraved head, and flexo head
- IGT AIC2-5 T2000 Paper Coating Testing unit
- IGT High Speed inking unit
- RK Flexiproof 100 Ink Proofing System
- BYK Gardner 75 Degree Gloss Meter

LIGHT SCATTERING INSTRUMENTATION

- Brice-Phoenix universal photometer
- Brice-Phoenix differential refractometer
- Chromatix KMX-6 low-angle laser photometer with autocorrelator interfaced to an HP-85 computer
- Chromatix KMX-16 laser differential refractometer
- Wyatt Dawn-Flow laser LSI in-line with SEC system
- 2.0 mW solid-state transmission light scattering apparatus/camera

MICROSCOPY/IMAGING

- Zeiss Sigma VP FEG-SEM with Thermo System 7 EDS and WDS X-ray detectors
- Bruker Icon AFM with ScanAsyst with Nanoscope V controller, Large-sample, 90-micron scan range system, Closed loop scanner, Imaging Modes: PeakForce QNM (Quantitative Nanomechanical Mapping, PeakForce TUNA, Torsional Resonance TUNA, Conductive AFM, Tapping Mode, Contact Mode, Force-Distance Measurements
- Zeiss LSM 710 confocal laser scanning microscope
- Zeiss Smartzoom 5 digital microscope with Shuttle and Find module
- Zeiss Discovery V8 light microscope with AxioCam ERc 5s digital camera
- Nikon optical polarizing microscopes with video and hot stage
- Nikon compound and dissecting microscopes with video, 35mm, and digital imaging capability
- Kodak DC290 digital microscopy system
- Leitz optical polarizing microscope
- Leica EM UC6 Ultramicrotome and Cryoultramicrotome FC6
- Bromma LKB 7800 knife maker
- Reichert-Jung FC-4E cryo-microtome
- Keyence VHS 600 digital microscope with 3D imaging capability, automated Z-axis control, multi-angle observation base, cross-polarization capability and magnification range from 20-1000X.
- Vision Research Phantom v5.1 color, high-speed camera and 24-70mm and 70-200mm lenses
- Leica TXP sample preparation system
- Bruker Anasys nanoIR3 AFM-IR
- Oxford Instruments Cypher Asylum Research AFM

SURFACE ANALYSIS

- Reichert SR7000DC Surface Plasmon Resonance Spectrometer
- Quartz Crystal Microbalance (QCM-D) E4 system (Q-sense)
- Gaertner Scientific LSE-Stokes ellipsometer
- Ramè-hart goniometer
- Microphotonics Pin on Disc Tribometer
- Bruker DekTakXT Surface Profile Measuring System
- ThermoFisher ESCALAB 250Xi X-Ray Photoelectron Spectrometer (XPS)

OSMOMETRY

- Knauer membrane osmometer
- Knauer vapor phase osmometer

PHOTOVOLTAIC CELL FABRICATION/ANALYSIS

- AM1.5 solar simulator (Photo Emission Tech. Inc.)
- Keithley 2400 source unit for current density-voltage measurement
- ProCleaner™ Plus UV/ozone system
- Q150T Turbo-Pumped Sputter Coater
- Lakeshore Cryotronics CRX-VF Cryogenic Probe Station
- Bentham PVE300 Photovoltaic Characterization system
 - Bentham 610 light source (x3)

PARTICLE SIZE ANALYZERS

- MATEC capillary hydrodynamic fractionation unit, (CHDF 2000 with autosampler)
- Horiba laser scattering particle size analyzer
- Microtrac S3500 Basic Dry Multi-Laser Particle Size Wet Analyzer - (Dry Range: 0.7 – 1000 microns)
- Microtrac Zetatrac Ultra with Internal Probe (Range 0.0008 - 6.5 microns)

POLYMER PROCESSING

- Coperion ZSK 26mm megacomponent reactive extruder with full microprocessor control, gear pump, multiple screw shafts and elements, multiple loss-in-weight solids feeders, 10 gal liquid injection feed, side stuffer and take off system
- Prism TSE 16TC Bench top extruder
- Rotational molder
- Compression molder
- Pressure and vacuum forming equipment
- Extrusion facilities
 - *Wire coating, ribbon, blown film, annular, and Hann Slit dies*
- Haake Rheocord 90 twin-screw extruder
- Cober model LBM 1.2A Microwave/Convection oven
- RF Welders (10 kW, 1.2 kW)

POLYMER TESTING – PHYSICAL

- MTS Insight 10 (2000 lbs-force capacity) universal test machine
- MTS Landmark (110,000 lbs-force capacity) universal test machine
- MTS 810 (20,000 lbs-force capacity) universal test machine with *variable temperature/atmosphere chamber (-200°C to 350°C)*
- MTS Alliance RT/10 with DX2000 extensometer
- TA ElectroForce 3300® Series fatigue tester fitted with *variable temperature/atmosphere chamber (-150°C to 350°C)*
- Instron Dynatup 8250 Instrumented Impact Tester
- Polyken Probe-Tack tester, testing machine, model 80-02
- Custom Scientific Izod impact tester
- Melt deflection testing equipment
- Kruss tensiometer

- First Ten Angstroms FTA200 goniometer
- Tinius Olsen Izod impact tester
- Proto-tech four-chamber fatigue cycling station

POWDER COATINGS

- Cyclomix 5L premixer
- Coperion ZSK-30 twin-screw extruder
- Micron Powder System Bantam mill with cryogenic support for processing
- Kemutec sieve (65-145 μm size)
- Nordson spray booth with tribo-charging and corona-charging spray guns
- Plastic Flame Systems powder pistol flame spray
- Thermoelectric Company cure plate (gel time recorder)
- Sames fluidized bed
- IKA Works Inc. laboratory analytical mill
- VWR Model 1685, horizontal air flow oven, 25 cu.ft. capacity, 40 to 260°C temperature range
- Fostoria Industries experimental infrared curing oven, 3 zone 6 bank variable wavelength IR with conveyor
- Tangent Systems, Inc. Tempest data logger. 500°F maximum service temperature

RHEOLOGY

- TA Instruments ARES LS2 rheometer with force convection oven, extensional viscosity fixture, UV curing option, and dielectric thermal analysis option
- TA Instruments ARES G2 and AR1500EX rheometers
- TA Instruments ARES G2 with G2 Force Convection Oven
- Rheometric Scientific SR-5000 dynamic and steady state testing from -40°C to 250°C including Peltier, heated plates, and cup and bob stages
- Brookfield DV-III Ultra programmable rheometer
- Stormer viscometer
- Seiko Instruments SDM 5600 dynamic mechanical spectrometer with DMS110 bending/shear and DMS210 tensile modules
- Polymer Laboratories DMTA Mk III dynamic mechanical thermal analyzer
- Haake TP-24 rheometer
- Contraves low-shear 30 viscometers
- Cannon-Ubbelohde and zero-shear viscometers
- Instron Capillary Rheometer Model 3211
- Tinius Olson Extrusion Plastometer (melt indexer)
- Custom Scientific Extrusion Plastometer (melt indexer)
- Brabender Plasticorder
- ICI cone and plate viscometer
- Bohlin RH7 Flowmaster advance capillary rheometer

SPECTROSCOPY – NMR

- Bruker AVANCE III 600 MHz high performance digital NMR spectrometer with autosampler
- Varian UNITY-INOVA 500 MHz spectrometer
- Varian UNITY-INOVA 400 MHz solids spectrometer
- Varian MERCURY 300 spectrometer
- Varian MERCURY 200 spectrometer
- Bruker MSL-200 solids spectrometer

SPECTROSCOPY - IR

- Bio-Rad FTS 6000 Step-Scan spectrometer with Stingray IR imaging software and photoacoustic and ATR attachments with UMS 500 microspectroscope
- Perkin-Elmer 1600 Series FTIR
- Nicolet IR/42 FTIR
- Nicolet 6700 FTIR with Smart Orbit diamond ATR accessory
- Nicolet 6700 FTIR
 - GATR sampling accessory kit
 - Smart iTR ATR accessory
 - VeeMax variable angle specular reflectance accessory
 - In-sample compartment for TGA/IR analysis
 - Heated contact ATR accessory
 - Pressure cell accessory
- Nicolet Continuum IR Microscope
- Nicolet Antaris II near-IR
- Digilab Scimitar FTS-2000
- Mettler Toledo ReactIR 1000 with variable optics module for remote sensing with diamond and silicon probes
- Mettler Toledo ReactIR iC10 with diamond probe and controlled heating platen
- Mattson Galaxy series FTIR with TGA interface
- Bruker Vertex 80v FTIR
- PerkinElmer Frontier FT-IR Spectrometer

SPECTROSCOPY – UV/VIS

- Perkin-Elmer Lambda 6 UV/Vis spectrophotometer interfaced to an Epson PC
- TECAN M1000 Infinite plate reader
- Thermo Scientific Multiskan FC photometer
- Science Tech SS150W solar simulator
- Agilent Cary Series Uv-Vis-NiR (Near iR) Spectrophotometer

SPECTROSCOPY - MASS

- PerSeptive Biosystems MALDI mass spectrometer with Voyager RP Biospectrometry workstation, molecular weight in the millions, end group analysis below 25,000

SPECTROSCOPY – RAMAN

- Thermo DXR Raman spectroscopy system

MAGNETOMETRY

- Quantum Design MPMS3 Superconducting Quantum Interface Device (SQUID) Magnetometer

THERMAL/CALORIMETRIC ANALYSIS

- Govmark CC-1 cone calorimeter
- TA Instruments Discovery TGA with auto-sampler
- TA Instruments Discovery TGA with Discovery Mass Spectrometer
- TA Instruments DSC2000 with auto-sampler
- TA Instruments TGA500 with auto-sampler
- TA Instruments Q400EM TMA
- TA Instruments Q400 TMA
- TA Instruments Q800 DMA with RH control option
- TA Instruments VTI-SA+ Vapor Sorption Analyzer
- Mettler Toledo Flash DSC 2+
- Mettler Toledo Polymer DSC R with TS0801RO Sample Robot
- Mettler Toledo STAR System DSC 3+
- Mettler Toledo STAR System TGA/DSC 3+

SOFTWARE FOR SIMULATION AND DESIGN OF EXPERIMENTS

- HPC cluster with 336 cores and 1.4 TB of RAM
- HPC cluster with 2000 cores
- Finite Element Modeling (MOOSE)
- Solidworks
- Cosmosworks
- Cosmosfloworks
- Pro-E
- Minitab
- DOE Pro
- QI Macros
- Mathcad

WOOD COMPOSITES

- Watlow/SRT 180 Ton Hydraulic Press w/26" x 26" heated platens
- Henschel FM L 40 mixer

X-RAY SCATTERING

- Xenocs Xeuss Small-Angle/Wide-Angle X-ray Scattering SAXS/WAXSS system with 2 and 10 meter configurations
 - Pilatus3 1M detector with a combined hybrid pixel Small and wide-angle X-ray scattering (SWAXS) module

- Grazing-Incidence Small-Angle X-Ray Scattering (GISAXS) Stage
- Large sample chamber compatible in either in vacuum or air

MISCELLANEOUS

- Positron annihilation spectroscopy (PALs) system
- Tenney T20RC20-A Environmental Chamber
- MicroFab Jetlab 4 micro printing system
- Gamry Potentiostat-galvanostat
- Advanced Measurement Technologies VERSASTAT4-400 DC voltammetry and corrosion system
- MBraun Labmaster (1800/1000), with single filter column gas purification system and antechamber
- Chem Glass 30 L reactor
- Edwards short path distillation system/wiped film evaporator
- Mettler Toledo Density XS system
- Orion AF8 Volumetric Karl-Fischer water analysis unit
- Varian 109Q ESR
- Hewlett-Packard 4192A impedance analyzer with HP-85 data station
- Time resolved, single-photon counting fluorescence spectrometer
- Nanosecond laser flash photolysis system
- Solartron 1255 HF frequency response analyzer with 1286 electrochemical interface
- Parr reactors with 300 mL and 600 mL capacity
- Spontaneous combustion apparatus - ASTM E771
- Cyclone DNA synthesizer
- Fabrication shop
 - Machining
 - Computer aided manufacturing
 - Welding
 - Sheet metal
 - Glass shop
 - Electronics shop
 - Computer aided design
 - Automated test equipment
 - Prototyping equipment

MISSISSIPPI POLYMER INSTITUTE & THE ACCELERATOR

- Hysitron Triboindenter® nanomechanical testing system
- Objet Connex 350 multi-material 3-dimensional printing system
- Nvision LS100 and LS400 Advanced Laser Scanner for non-contact metrology, first article inspection, CAD file generation and re-engineering
- Instron 5582 Tensile Tester (up to 20,000 lbf) with environmental chamber capability

- SLS Sinterstation 2500+ rapid prototyping machine
- Tensilkut Izod sample preparation unit
- Tinius Olsen Model 882 Izod Impact Tester
- Tinius Olsen Model MP993 Extrusion Plastometer for Melt Flow Index (MFI)
- Tenney environmental chamber
- Constant temperature and humidity hot room with data logger (37⁰C)
- Constant temperature and humidity cold room with data logger (4⁰C)
- Continuum Fourier Transform Infrared Spectroscopy (FTIR) Microscope
- Buehler Metaserv 250 with Vector Powerhead microscopy sample preparation unit
- Cincinnati Milacron CAMAC VSx 85-ton injection molding machine
- Microtrac 3500 Bluewave Particle Size Analyzer (wet and dry, 0.01 to 2,800 microns)
- Thermo-Nicolet 6700 Fourier Transform Infrared Spectrometer (FTIR) with Continuum FTIR Microscope
- Waters Acquity Ultra Performance Liquid Chromatograph (UPLC) with Evaporative Light Scattering Detector (ELSD) and Photodiode Array Detector (PDA)
- TA Instruments Q2000 Differential Scanning Calorimeter (DSC)
- TA Instruments Q500 Thermogravimetric Analyzer (TGA)
- 30 and 50 Liter Pilot Scale Chemical Reactor Vessels
- Rhopoint WP Minimum Film Formation Temperature Apparatus
- Thermo Scientific Nanodrop 2000c UV-Vis Spectrometer
- Waters Gel Permeation Chromatograph with Refractive Index and Photodiode Array Detectors
- Thermo Scientific TSE 24mm MC (modular compounder) Co-rotating 1000 rpm 50kg/hr output, 40 L/D 1 main feed port and 3 top vent ports, Clam shell design with modular screw design, Max Temperature – 450 oC with 10 temperature zones.