

AAF/UWMilwaukee Equipment List

(2_20a) * NEW

Surface Area and Porosimetry Measurements: *Micromeritics ASAP 2020*. Measures surface area of powders using single or multi-point BET. Full BJH Adsorption/Desorption isothermal plots measured from $<.01$ to $.99(P/P_0)$. N_2 gas BET surface area, T-plot micropore area, BJH surface pore area, Single point total pore volume, T-plot micropore volume, DFT analysis.

X-Ray Diffraction (XRD) Bruker D8 Advanced: Cu source, BB and Goebel Mirror geometry, Linear XE detector 0.5 to 130° , Flat sample and Capillary attachment. Two axes: Theta:Theta, Theta and Rocking Scans. High Temperature Stage (RT to 1000°C) Identification of Crystal Phases, Weight percentages of mixed phases, Crystal size ($<50\text{nm}$).

X-Ray Photoelectron Spectroscopy (XPS/ESCA): *PHI 5400 ESCA System*. Surface elemental ($>\text{Li}$) and chemical analysis (top $1-2\text{ nm}$) of solids, thin films and powders. Mg and Al X-ray source. Argon sputtering for surface cleaning and depth profiling ($0-50\text{nm}$).

Raman Microscope Spectroscopy: *Renishaw, Inc 1000B*. Measures molecular vibrations of solids, powders, and liquids ($4000-100\text{cm}^{-1}$ - Stokes lines only). HeNe laser (633nm). With 20X and 50X objectives (laser spot size ~ 5 and 2microns 10mWatts).

Secondary Electron Microscope/Energy Dispersive Spectroscopy (SEM/EDS): *JEOL JSM-6460LV* Large chamber, variable pressure (5×10^{-6} to 2.0 Torr). SSB detector, EDS light element Structural image analysis of solids and powders, surface morphology, composite material analysis and failure analysis. Magnification from 50X to $10,000\text{X}$. Elemental analysis down to Carbon (top $1-4\text{ microns}$).

Fourier Transformed Infrared (FTIR): *Brucker Corp VECTOR 22*. Molecular spectroscopy to identify organic (C-H, C-O...) or some inorganic (Si-O...) bands in solids, powders, or liquids. Attenuated Total Reflection attachments (MIRacle: Diamond, Ge, ZnSe) for minimum sample preparation. Multi-Variable Specular Reflectance (VeeMax: $30-80^\circ$) for thin film and monolayer samples.

Mattson Galaxy 3000 with Quantum IR Microscope. Transmission (Diamond window attachment to measure fibers and small particles) or Reflectance/Absorption mode.

UV/Visible Spectroscopy: *Ocean Optics SD2000*. Modular spectrometer with UV (Deuterium Lamp $215-600\text{nm}$) and Visible (Tungsten Halogen Lamp $400-1100\text{nm}$) light sources. Dual UV ($200-750\text{nm}$)/Visible ($525-1100\text{nm}$) spectrometers. Transmission/Absorption measurements of liquids and Reflectance measurements of solids and powders. Measure concentrations of "active" constituent in liquids. Color and optical band structures of solids and powders.

3D Laser Confocal Microscope: (405nm). *Olympus OLS4100* 3D optical images to measure: Profiles, Surface and Linear Roughness, Wear Surfaces and Volumes, Particle Size Distributions.

UVVIS Ellipsometer: *Horiba UVISEL*. Film thickness measurements, nm to $1-3\text{ microns}$. Optical properties of films (n, k , dielectric parameters)

Atomic Force Microscope (AFM): *Agilent Technologies 5420 AFM*. Surface topography and roughness (dry or in liquids). $50\text{X}50\text{ micron}$ XY scans with Z features (sub- nm to 2 microns). Contact (hard samples) or Non-contact (soft or easily damaged samples) tips. Force spectroscopy for measurement of tip/sample adhesion.

Nano Indention and Scratch: *Agilent Technologies Nano Indenter G200*. Modulus and Hardness measurements of metals, glasses, polymer solids. Surface profiles, critical load, film delamination, and estimate of plastic deformation. Continuous Stiffness Measurement (CSM) attachment for the continuous measurement of modulus and hardness (~100-3000nm).

Thermal Gravimetric Analysis/Differential Thermal Analysis (TGA/DTA): *TA Instrument SDT 650*. Thermal Analysis of powders, liquids and solids (RT to 1300 °C). Measurement of mass and temperature difference as a function of temperature or time (In flowing gas [N₂, Ar...] or a rough vacuum [100mTorr]). Water loss, thermal decomposition, solid state reaction, or phase changes can be measured.

Differential Scanning Calorimetry (DSC): *TA Instrument Q200*. Thermal Analysis of powders, liquids and solids (-45C to 400C). Measurement of glass transition temperature, crystallization and melt temperatures and heats of enthalpies, curing and cure kinetics, heat capacity, etc. (as a function of temperature or time).

Dynamic Mechanical Analyzer (DMA): *TA Instruments Q800*. Measurement of Storage and Loss Modulus (function of temperature {-50-400C} and frequency {1-100Hz}). Stress/Strain and Creep curves vs Temperature/Frequency. Clamps: cantilever, 3 point bend, and thin film tension .

Particle Size Distribution: *Brookhaven Instrument Corp 90 Plus/BI-MAS*. Measurement of particle and agglomeration size in liquid suspensions (3-3000nm). Dynamic light scattering at 15° or 90°. 5° to 75° temperature range.

PSD _ Malvern MS3000*: Laser Diffraction Wet/Dry 200nm-3mm

Zeta Potential: *Brookhaven Instrument Corp Zeta PLUS/PALS*. Surface zeta potential measured via Phase Analysis Light Scattering and electrophoretic mobility of particles suspended in liquids. 5° to 75° temperature range.

UWM Affiliate instruments AAF has excess:

Raman Confocal Microscope (532nm and 785nm) Horiba Xplora-PLUS

Thin Film Deposition E-Beam, Ar Sputtering

Hitachi S-4800 FE-SEM