The Institute for Soft Matter Synthesis and Metrology, or I(SM)$^2$, at Georgetown University has established two shared facilities for engaging industrial and academic researchers from relevant disciplines:

- **I(SM)$^2$ Characterization Lab**, equipped with state-of-the-art instruments for in-depth measurements in the following categories: microscopy, rheometry, light scattering, microcalorimetry, spectroscopy, mechanical test, and surface analysis.  
  Lab contact: Dr. Xinran Zhang, email: xz247@georgetown.edu

- **I(SM)$^2$ Preparation and Evaluation Lab**, equipped with tools for sample preparation (such as milling, emulsification, and homogenization) and quick evaluation of sample properties including particle size, surface charge, light absorption, wetting, and others.  
  Lab contact: Dr. Ian Morrison, email: im334@georgetown.edu

We are the Mid-Atlantic reference site for a few renowned instrument manufacturers.

Combined with our affiliated members’ expertise in soft matter research, we can solve your problems by providing detailed consultancy and systematic measurements.
Equipment in the I(SM)$^2$ Characterization Lab

Microscopy

• **Scanning Probe Microscope (SPM), or Atomic Force Microscope (AFM) mounted on an inverted fluorescence microscope**
  
  **Model:** NTEGRA Prima AFM (NT-MDT) & Ti-S (Nikon)
  
  **Capabilities:**
  1. Measurements of surface topography with nanometer resolution;
  2. Simultaneous topographical and fluorescence imaging;
  3. Live cell imaging in buffer solutions;
  4. Measurements of localized mechanical (adhesion and stiffness), electrical (I-V and surface potential), or thermal properties (surface temperature and thermal conductivity).

• **Bright-Field/Fluorescence Microscope with High-Precision Micromanipulators**
  
  **Model:** Ti-E (Nikon)
  
  **Capabilities:**
  1. 10x, 40x, 60x (oil) lenses available;
  2. Filter cubes that cover the whole near-UV to near-IR spectra for fluorescence imaging;
  3. Fully automated system that allows for recording time-lapse, focal series and tiling (taking images at each section of a large area and stitching them together);
  4. High-precision micromanipulation and microinjection;
  5. Temperature controlled stage (0-100 °C) available.
Rheometry

- **Parallel-Plate/Cone-Plate Rheometer**
  - **Model:** MCR302 (Anton Paar)
  - **Capabilities:**
    1. Oscillatory measurements of storage and loss moduli for viscoelastic materials;
    2. Rotational measurements of viscosity for viscous liquids;
    3. Measurements of time- or temperature-dependent flow or viscoelastic behavior;
    4. Peltier temperature control device (-40 to 200 °C) available.

- **Dual-Head Rheometer**
  - **Model:** MCR702 TwinDrive (Anton Paar)
  - **Capabilities:**
    1. Double-gap configuration that supports rotational viscosity measurements for dilute solutions and pure solvents;
    2. Direct strain control via bottom plate displacement;
    3. Counter rotation of the two motors to control the vertical position of the static layer;
    4. Oscillatory measurements of storage and loss moduli for viscoelastic materials;
    5. Measurements of time- or temperature-dependent flow or viscoelastic behavior;
    6. Convection temperature control device (-20 to 180 °C) available.
    7. Polarized microscope and transparent measuring systems for synchronized imaging and rheological measurements. (**New capability added December, 2016.**)

**Note:** We are the Mid-Atlantic reference site for Anton Paar GmbH, and the first US lab to have an MCR702 TwinDrive rheometer.
Light Scattering

- **Dual-Beam Cross-Correlation Light Scattering Instrument**
  
  **Model:** 3D LS spectrometer (LS Instruments)

  **Capabilities:**
  
  (1) Particle sizing for both dilute and concentrated solutions (multiple scattering suppression);
  
  (2) Molecular mass measurement;
  
  (3) Programmable dynamic light scattering (DLS) measurements at multiple angles;
  
  (4) Sample goniometer that enables measurements of non-ergodic samples;
  
  (5) Square cell for extremely concentrated solutions;
  
  (6) Sample vat temperature controlled by external circulator (10 - 70 °C).

  Note: LS Instruments is by far the only manufacturer in the world that provides reliable dual-beam, multiple-angle DLS systems. We are the Mid-Atlantic reference site for LS Instruments.

Calorimetry

- **Low-Volume Isothermal Titration Calorimeter**
  
  **Model:** Nano-ITC (TA Instruments)

  **Capabilities:**
  
  (1) Measurements of molecular binding, dissociation, or reaction kinetics in dilute solutions, especially suited for biological samples with limited availability;
  
  (2) Temperature range: 2 - 80 °C.
• **Multi-Cell Differential Scanning Calorimeter**  
  **Model:** MC-DSC (TA Instruments)  
  **Capabilities:**  
  (1) Measurements of thermal transitions in solid as well as liquid samples;  
  (2) Temperature range: -30 - 150 °C;  
  (3) Large sample capacity (~ 1 g) allows for enhanced detection of small heat effects.

**Spectroscopy**

• **UV-vis-near IR Absorption Spectrometer**  
  **Model:** Cary 5000 (Agilent)  
  **Capabilities:**  
  (1) Absorption spectroscopic measurements in the 175-3300 nm range for solutions, thin films, and powders (internal diffuse reflectance);  
  (2) Peltier cuvette holder with regular working temperature range of -10 - 150 °C. Lower temperatures down to -55 °C are also possible with pre-cooled circulating fluid.

**Mechanical Test**

• **Universal Mechanical Tester (*** New equipment acquired July, 2017)**  
  **Model:** 5965 Dual Column Testing System (Instron)  
  **Capabilities:**  
  (1) Tensile and shear tests with load capacity up to 5 kN and wide speed range (0.001 to 3000 mm/s);  
  (2) Pneumatic grips that maintain constant gripping force on samples;  
  (3) Video camera for recordings of the tests that can be synchronized with the measured force curves;  
  (4) Extensometer for displacement measurement with an accuracy of 1 micron.
Surface Analysis

- **Surface Plasmon Resonance (SPR)**
  - **Model:** 404pi (BiOptix)
  - **Capabilities:**
    1. Measurements of molecular adsorption onto pristine or modified metal surfaces, such as binding of flowing small molecules by immobilized proteins;
    2. Fully automated multi-channel fluidics;
    3. Versatile surface chemistries.

**Note:** We are the Mid-Atlantic reference site for BiOptix.
Miscellaneous

- **Doctor-Blade Coater (MTI Corporation)**, 12”x24”, plate temperature up to 100 °C. (**New equipment acquired August, 2017.**)

- **Dual-extruder 3D printer (Leapfrog Creatr)** with multiple materials available (PLA, ABS, PVA, Nylon, etc.)

- **Benchtop plasma cleaner (PlasmaEtch PE25-JW)**

- **Stand mixer (Cole-Parmer Servodyne)** with speed/torque monitoring and control, 150 – 6,000 rpm

- **Universal spin-coater (Laurell Technologies)** with digital process controller, 100 – 12,000 rpm

- **Wafer spin-coater (MTI Corporation)**, 500 – 8,000 rpm

- **Analytical balance (Mettler Toledo)** with max weight of 120 g and readability of 0.1 mg

- **Benchtop centrifuge** with max speed of 4,000 rpm and 6x50 mL capacity

- **Sonicator, Vortex mixer, Hot plate**
Equipment in the I(SM)$^2$ Preparation and Evaluation Lab

Mixing and separation

- **Centrifugation**: Refrigerated model 5678 (Forma Scientific)
- **Shaking**: Dual Action (Polyscience)
- **Bench top roller**: (Wheaton)
- **Vortex mixer**: (Baxter)

Dispersing in liquid

- **Stirred media milling**: Szegvari Attritors Models 01STD and 01S (Union Process)
- **Milling media** of various sizes and composition
- **High shear rate emulsification**: Dispermat SL D-51580 (Reichshof, under upgrade)
- **High shear stress emulsification**: Labortechnik RE 162/P (Janke & Kunnel)
- **Ultrasonic homogenization**: Model CP130 (Cole-Palmer)
- **Rotor-stator homogenization**: PT 10/35 (Brinkmann)

Particle sizing

- **Particles in air**: Particle Size Distribution Analyzer Model 3603 (TSI)
- **Dilute, submicron** – Dynamic light scattering
  - Submicron Particle Sizer Model 370 (NICOMP)
  - N4 Plus Spectrometer (Coulter)
  - Zetasizer Model 3000HS (Malvern)
  - ZetaPALS (Brookhaven)

Particle charge

- **Electroacoustic signal (no dilution)**: Field ESA particle analyzer (PA)
- **Microelectrophoresis cell geometry**: Zetasizer model 3000HS (Malvern)
- **Parallel plate geometry**: ZetaPALS (Brookhaven)
Flow – rheology

- **CS Rheometer** – controlled stress, manual (Bohlin)
- **C-VOR Rheometer** – controlled stress, more automated (Bohlin)

Spectral properties

- **Visible** - Spectronic 20 (Bausch & Lomb – for training)
- **UV-Vis** - DU 7400 spectrophotometer (Beckman Coulter)

Electrical properties

- **Conductivity meter** – pS-cm range (Scientifica)
- **Dielectric measurement** - Adjustable-gap, parallel plate cell and electronics

Chemical properties

- **Water content** - by Karl-Fisher - 832 KF Thermoprep (Metrohm)
- **Surface chemistry by IGC** - 5890 Series II gas chromatograph (HP, being repaired)

Polymer properties

- **Polymer size in solution**: DAWN EOS Light scattering with Optilab DSP Interferometric refractometer (Wyatt Technologies)

Wetting properties

- **Contact angle analyzer** - Goniometer model 100-00 115 -Rame-Hart with DEK 21AE04 digital camera – Imaging Source
Imaging

- Photomicroscopy - DM IRB inverted microscope (Leica)

Miscellaneous

- Electrometers
- multimeters
- power supplies
- balances
- circulators
- syringe pumps
- computers
- compressor
- refrigerator
- oven