Equipment List and Material Techniques Available at the Advincula Research Laboratory, PETRO Case, and at Case Western Reserve University (CWRU):

- Inquiry for access and cost per hour or sample - please discuss with Dr. Advincula (rca41@case.edu)
- Other instruments are available in other research groups and instrumentation centers within campus. Their own access rules and charges apply.
- Other testing facilities outside the campus is available.

General Instrumentation

1. Electrochemical Techniques
    a. One Step Chronoamperometry
    b. Two Step Chronoamperometry
    c. Chronopotentiometry
    d. Linear Scan Voltammetry
    e. Ramp Cyclic Voltammetry
    f. Stair Case Cyclic Voltammetry
    g. Electrochemical Impedance
2. Corrosion
    a. Weight Loss Measurement
    b. Open Circuit Potential Measurement
    c. Tafel Plot
    d. Anodic Polarization
    e. Cathodic Polarization
    f. Galvanic Corrosion
    g. Cyclic Polarization
3. Microscopy
    a. Optical Microscopy
        i. Polarized Optical Microscopy (Dr. Korley Lab)
        ii. Bright Field Microscopy (Dr. Zorman)
        iii. Dark Field Microscopy (Dr. Zorman)
        iv. Fluorescence Microscopy (Macro)
        v. Confocal Microscopy (SCSAM)
    b. Electron Microscopy
        i. Scanning Electron Microscopy
        ii. Transmission Electron Microscopy
4. Atomic Force Microscopy

a. Contact Mode
b. Non-contact mode
c. Tapping mode
d. Force Spectroscopy
e. Frictional Force Mapping
f. Scanning Voltage Microscopy (Conducting AFM)
g. Scanning Probe Microscopy

5. FT-IR Techniques
    a. Transmission Mode
    b. Reflectance Mode
    c. ATR-IR
    d. FT-IR Imaging
    e. ATR-IR Imaging
    f. Specular Reflectance
    g. Photoacoustic Absorption Spectroscopy
    h. Polarization modulation infrared reflection absorption spectroscopy
6. 3D Printing
    a. 3D Touch Printer from Bits from Bytes
    b. Filament Extruder
    c. 3D Printer – Fortus 250mc
    (Thinkbox: http://engineering.case.edu/thinkbox/equipment)
    d. 3D Printer – Fortus 400mc
    (Thinkbox: http://engineering.case.edu/thinkbox/equipment)
7. Patterning
    a. Photolithography (Dr. Zorman)
        i. Spin coater for photoresist application
        ii. Exposure and Developing
        iii. Etching – Reactive ion etching Systems
    b. Laser Cutter
8. NSF-STC Center for Layered Polymeric Systems (CLiPS)
    a. Multilayer Extruder
    b. Rheometers
    c. Micro Compounder

Synthesis and Thin Film Fabrication Methods:

(1) Synthesis method: small molecules synthesis and polymerization techniques: Atom-transfer radical-polymerization (ATRP), Reversible addition-fragmentation chain-transfer polymerization (RAFT), Ring-opening polymerization (ROP).

Six fume hoods equipped with schlenk line, hot plates and vacuum pump are available on the 5th floor in RCA lab. Glove box is also available on the 3rd floor for rigid-condition operation. Different types of glassware and oven for synthesis and testing.

(2) Thin film fabrication in RCA lab: Layer by Layer method (LBL), Langmuir-Blodgett film (LB film), Spin-coating film and Drop-casting film.

Rheology testing Methods:

HAAKE MARS III Rotational Rheo-meter is also available in the Macro department.

Some rheology test standards, such as D445: test method for kinetic viscosity of transparent and opaque liquid; ISO12644: Determination of rheological properties of paste inks and vehicles; ASTM D7394-13: Rheological characterization of architerctural coating and D2196: Rheological properties of Non-Newtonian material by rotational viscometer are available.

Chemical or polymer analysis methods:

Basic characterization:

NMR 300 MHz on 5th floor in KHS building owned by Macro department, NMR 600 MHz and Matrix-assisted laser desorption/ionization (MALDI-TOF) are also available at basement in KHS building.

Gel permeation chromatography (GPC) with triple detector, UV-Vis spectrometer, Roman spectrometer and Fluorescence spectrometer analysis are available on the 5th floor in RCA lab. Infrared spectroscopy with multi-purpose measurement such as IR transmittance/absorption and IR imaging are also available on the 3rd floor of RCA lab.

Atomic force microscopy (AFM) analysis is available on the 5th floor of RCA lab. Scanning electron microscope (SEM) is also available on the 3rd floor in KHS.

Thermo-mechanical and X-ray analysis:

Thermo-gravimetric (TGA) analysis and differential scanning calorimetry (DSC) are available on the 5th floor of RCA lab. X-ray crystallography (XRD) analysis and polarized light microscopy (POM) are also available on the 3rd floor of KHS building. Dynamic mechanical analysis (DMA) lies at the basement of KHS building.

Thermal analysis standards, such as ASTM E793-06(2012): standard test method for enthalpies of fusion and crystallization by differential scanning calorimetry, ASTM E794-06(2012): standard

method for melting and crystallization temperatures by thermal analysis, and ASTM E928-08: standard test method for determination of purity by differential scanning calorimetry

Department equipment website: https://csescheduler.case.edu/emac/

Other accessible characterization in the campus:

Dynamic light scatter (DLS) in school of medicine and other laboratories

More equipment regarding the surface analysis and optical microscopy at the Swagelok Center administrated by Case School of Engineering are also accessible

Swagelok Center for Surface Analysis of Materials

I. PHI 680 Scanning Auger Microprobe
II. PHI Versaprobe 5000 Scanning X-Ray Photoelectron Spectrometer (XPS)
III. PHI TRIFT V nanoTOF Time-of-Flight Secondary Ion Mass Spectrometer (TOF-SIMS)
IV. Gatan Ilion+ Ion Polisher – surface preparation for SEM
V. Gatan PIPS – TEM sample preparation
VI. Fischione Nanomill 1040 – TEM specimen preparation system
VII. Plasma Cleaner

http://engineering.case.edu/centers/scsam/

Other Advincula Group Instruments

Perkin Elmer LS 45 Luminescence Spectrometer

Stellar Net Inc. Super Range Concave Grating Spectrometer for UV-VIS-NIR range from 220-1100nm

B&W Tek i-Raman Plus portable Raman spectrometer with Raman Micrscope

Dip Coater - Speedline technology P-6000 spincoater

Centrifuge

- Eppendorf Centrifuge 5415 D – 24 x 2.0 mL capacity rotor, speed up to 13,200 rpm

- Eppendorf Centrifuge 5702 – speed up to 4,400 rpm

March Plasmod GCM 200 Plasma Cleaner

CWRU Chemistry Department

I. Three Thermo Finnigan Ion Trap mass spectrometers each equipped with an Electrospray Ionization (ESI) source.

   A. LCQ Advantage is used in direct infusion mode. Samples that are relatively pure and therefore do not need chromatographic separation are injected directly into the ESI source.

   B. LCQ DECA and an LCQ DECA XP Max each having two possible modes of operation:

      1. Direct infusion. Samples that are relatively pure and therefore don't need chromatographic separation can be injected directly into the ESI source.
      2. HPLC/MS. Components in a complicated mixture must first be separated before being injected into the ESI source. The Surveyor HPLC system can easily be connected to the ESI source thus allowing each component in the mixture to be mass analyzed as it elutes from the HPLC column.

II. RATOS MS25 double focusing electrostatic/magnetic sector mass spectrometer. Used for exact mass analysis on pure samples. Available in electron impact, FAB or CI modes.

III. Bruker Sentinel FT Raman.

IV. Two Beckman HPLC's each with a scanning UV/vis photodetector.

V. Two Varian Eclipse Fluorimeters:

   A. Peltier thermostated cuvette holders.

   B. Used with the Stopped-Flow Kinetics apparatus to measure rapid rates of reaction.

VI. Four Varian Cary 50 UV/vis spectrophotometers:

   A. Two of these instruments are equipped with Peltier thermostated cuvette holders.

   B. Used with the Stopped-Flow Kinetics apparatus to measure rapid rates of reaction.

VII. Two "Hi Tech" Stopped Flow Kinetics devices. These are used along with the Varian fluorimeters or UV/vis spectrometers for measuring the rate of fast reactions in solution.

VIII. Two Varian FS220 Atomic Absorption spectrometers for dissolved metal analysis. There are four modes of operation:

   A. Air Acetylene Flame.

   B. Vapor generation apparatus for Hg & metal hydride analysis at ppb levels.

   C. Graphite furnace with auto sampler for analysis at ppb levels.

   D. An AutoSampler which can be used with either instrument in flame or vapor generation mode.

IX. Four Cypress Systems anodic stripping stations for analysis of dissolved metals at ppb levels.

X. Two Midac FTIR spectrometers, mid IR only.

XI. A Hewlett Packard GC/MS.

XII. Three Thermo Electron TRACE Gas Chromatographs. Each equipped with a Split/Splitless injector, a TCD detector and an FID detector.

https://www.case.edu/artsci/chem/faculty/_research/instruments.html

Specific Instrumentation Category

Particle Analysis

RCA Lab

- Atomic Force Microscopes (AFM) (Park Systems and Agilent)
- UV-Vis-NIR spectrophotometer (StellarNet Inc.)
- Fluorescence Spectrometer (PerkinElmer)
- Centrifuge (4000 rpm max and 13,000 rpm max)

Department

- Rheometers (ARES G2, MARS III and Anton Paar)
- Scanning Electron Microscope (SEM) (JEOL)
- Wide Angle and Small Angle X-ray Diffraction
- Powder XRD (Rigaku)
- Confocal Microscope (Leica)

University

- Dynamic Light Scattering (DLS)
    - Karathanasis Group
- Transmission Electron Microscope (TEM)
    - Zeiss Libra 200EF TEM

- FEI Technai TEM
- Swagelok Center for Surface Analysis of Materials (http://engineering.case.edu/centers/scsam/)

Thermo-mechanical Analysis

RCA Lab

- Thermogravimetric Analysis (TGA) (TA Instruments)
- Differential Scanning Calorimeter (DSC) (TA Instruments)
- HPHT Pressure Vessels (up to 350^{o}C and 3000 psi)

Department

- Dynamic Mechanical Analysis (DMA) (TA Instruments)
- Rheometers (ARES G2, MARS III and Anton Paar)
- Mechanical Test (Tensile, Compression, Adhesion, Cyclic, etc) with Temperature control

University

- Nanoindenter
  - http://engineering.case.edu/centers/scsam/
- Advanced Manufacturing and Mechanical Reliability Center (AMMRC)
  - Advanced Deformation Simulator MTS Model 311.31
  - Advanced Forming Apparatus MTS Model 866.725
  - Instru-Met/Instron Model 1125
  - Instru-Met/Instron Model 1130
  - High Pressure testing
    - MTS Machine
    - Innovare LES Explorer
  - Download complete list of instruments and capabilities here: (http://ammrc.case.edu/sites/ammrc.case.edu/files/ammrc_flyer.pdf)

Drilling Fluid Tests

RCA Lab

- High Temperature High Pressure (HTHP) Filter Press
- Density/Mud Balance
- Cup Funnel
- Sand Content
- Centrifuge (4000 rpm max and 13,000 rpm max)
- HPHT Pressure Vessels (up to 350^{o}C and 3000 psi)
- pH meters
- Electrochemical set-ups
- Blenders and mixers
- Corrosion monitoring
- Resistivity meters

Department

- Viscometers, Rheometers (ARES G2, MARS III and Anton Paar)

Standards

- API RP 13B-2 – Recommended Practice for Field Testing Oil-Based Drilling Fluids

ACCESS TO EXTERNAL TESTING METHODS OF POLYMERS FOR OIL & GAS

Honeywell, PropTester, and Argen Polymers

LINK TO INDUSTRY STANDARDS FOR OIL AND GAS

http://www.rcapoly.net/petro-case.html