

Testing / Capabilities

The extensive equipment available to the NDSU Center for Surface Protection (CSP) allows for the performance of conventional testing and characterization (ASTM standard tests). In addition, a wide variety of electrochemical tests and accelerated weathering makes CSP a one-stop center for corrosion, polymers and coatings R&D. We are available to discuss your applied and basic research projects to assist in solving your corrosion and coatings challenges.

Additionally, we can tailor projects for your companies' unique needs. Our team of scientists, in collaboration with engineers, allows the creation of custom set-up that can accommodate non-standard tests.

The following list is a summary of CSP capabilities. New instruments, set-ups and accessories are continually added, generating additional capabilities.

Standard Test Methods

ASTM 016	Standard Terminology for Paint, Related Coatings, Materials, and Applications
ASTM 0465	Acid Number
ASTM 0522	Mandrel Bend Test
ASTM 0523	Specular Gloss
ASTM 01474	Indentation Hardness of Organic Coatings (Knoop hardness)
ASTM 01544	Color of Transparent Liquids (Gardner Color Scale)
ASTM 01545	Viscosity of Transparent Liquids by Bubble Time Method (GardnerHoldt Viscosity)
ASTM 01640	Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
ASTM 02196	Rheological Properties of Non-Newtonian Materials by Rotation (Brookfield-type) Viscometer
ASTM 02369	Volatile Content of Coatings (percent solids)
ASTM 02794	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM 03359	Measuring Adhesion by Tape Test (Pull-off adhesion)
ASTM 03363	Film Hardness by Pencil Test
ASTM 04287	High-Shear Viscosity Using a Cone/Plate Viscometer
ASTM 04366	Hardness of Organic Coatings by Pendulum Damping Tests (Konig hardness)
ASTM 05402	Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs

Accelerated weathering

ASTM B117	Salt fog chamber
ASTM D5894	Prohesion cycle
ASTM D4585	Cleveland Condensation test
ASTM D4329, ASTM D4587, G154	QUV exposure
ASTM D6695, G154	Qsun exposure
ASTM G153, G53	Weatherometer

Electrochemical testing

Electrochemical Impedance Spectroscopy

Electrochemical Noise Measurements

Open circuit Potential Monitoring

DC polarization

AC_DC_AC tests

Scanning probe techniques

SVET, SIET, SPET, SLEIS, SECM

Customized tests:

CSP personnel can evaluate the needs of the research partner and customize samples' set-up and apply the most suitable test methodology. CSP can access equipment available in both the Coatings and Polymeric Materials Department (CPM) and the Center for Nanoscale Science and Engineering (CNSE).

Equipment available in the Coatings and Polymeric Materials Department (CPM)

- Scanning Vibrating Electrode Technique (SVET)
- Digital Instruments Nanaoscope IIIa Atomic Force Microscope (AFM) and scanning tunneling microscope
- Digital Instruments DI-3100 AFM: tapping, contact, nanoindentation, and conductive AFM techniques
- Numerous Gamry PC-3s and PC-4 used for electrochemical measurements
- Q-Fog Chamber (2): One running ASTM G85 A5 and one running ASTM B117
- Q-UV Accelerated Weathering Chamber (2): running ASTM G155 (UVA and UVB lamps available)
- Q-Sun 1000 xenon arc weathering chamber (2): typically running modified ASTM D6695, 340 nm lamps
- MacBeth Color-Eye 7000: color spectrometer
- TA Instruments DMA Q800, (dynamic mechanical analyzer): film/tension clamp, dual cantilever clamp, three-point bend clamp, and gas cooling accessory
- TA Instruments DSC Q1000, (dynamic scanning calorimeter): refrigerator and liquid nitrogen cooling systems, MDSC and photo-DSC capabilities
- TA Instruments TGA Q500, (thermogravimetric analyzer): platinum sample pans
- TA Instruments TMA 2940, (thermomechanical analyzer): expansion, macro expansion, and penetration probes
- Waters GPC: photodiode array detector, refractive index detector; average molecular weight, weight average molecular weight, and PDI
- Instron 5542 Tensile tester: 100 N load cell, environmental chamber, and Bluehill v.2 software
- TA 2990 Micro Thermal Analyzer: scanning thermal microscope (AFM)
- FTÅ 125 Contact Angle/Surface Tension Analyzer: used for quick and accurate measurement of contact angles and surface tension with CMC analysis
- Surface Tensiometer: differential bubble pressure unit
- Varian Cary 5000 UV-Vis-NIR spectrometer: variable angle specular reflectance and diffuse reflectance accessories
- PSS Nicomp Particle Sizing Systems 780 and 380: 380/DLS submicron Particle sizer has a size range of 3 nm to 5 microns and the 780 SPOS single Particle optical sizer has a range of 0.5 to 2500 microns.
- Bruker FT-IR: has Raman and ATR capabilities
- Nicolet FT-IR: Photoacoustic, Real-time, and ATR capabilities
- Raman Imager

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Equipment available in the Center for Nanoscale Science and Engineering (CNSE)

- Buehler Ecomet 3000 Grinder/Polisher with AutoMet 2000 Head and Primet 2000 Dispenser
- Buehler Isomet 4000 Linear Precision Saw; CNSE Buehler SimpliMet 1000 Automatic Mounting Press
- Custom Built Gas Jet Erosion Tester
- Kurt Lesker CMS-18 Sputtering System Sputter Deposition tool This tool will deposit solid materials on a substrate by means of sputter deposition
- Olympus BX60M Inspection Microscope with Mag 1000x with camera and image capture software
- Agilent 1100 Series Gel Permeation Chromatography
Equipped with Diode Array Detector and Fraction Collector (Analytical or Preparatory Scale)
- Dual Channel S2000 Spectrometer — CNSE; Agilent 1100 Series HPLC with Autosampler
- Olympus DP70 Confocal Microscope; Equipped with Air Stabilization Table and Fluorescent Detection
- Stratagene Real Time PCR Thermocycler
- D8 Discover with GADDS Xray Diffractometer Performs a variety of Analytical Xray Techniques including Phase ID, MicroDiffraction, GIXR, GIXD, and Pseudo HRXRD
- 4 point probe with Jandel Current Source and Keithly voltmeter
Engineering M3D Optomec Direct Write Apparatus — Engineering
- GeneVac Centrifugal Evaporation Station
- Powdernium Robotic Powder Handling Station
- Symyx Coating Application Station
- Symyx Coating Formulation Station
- Symyx Polymer Synthesis Station
- Symyx/ChemSpeed A100 Stirred SemiBatch Reactor
- Tecan 8 Channel Coating/Dispensing Station Analysis
- Bohdan BA-100 Automated Balance
- Bruker FTIR Automated Plate Reader
- HP-Agilent GC-MS System with Autosampler
- Olympus Automated Imaging Analysis; Symyx Adhesion Screen System
- Symyx Parallel Dynamic Mechanical Thermal Analysis System
- Symyx Rapid Gel Permeation Chromatography System
- Symyx/First Ten Angstroms 2000 Surface Energy Measurement System
- Tecan Safire 2 Monochromator Microplate Reader

Tribology Toolset

- Zeiss Axiovert 40 Metallograph
- Agilent AFM/STM
- KLA TencorP-15 3D Profiler
- J.A. Wollam Ellipsometer
- Metrology preparation – Buehler (Isomet saw, Ecomet polisher, Simplimet press)
- Gas Jet Erosion
- Symyx Nanoindenter (Nanoindentation, Modulus, Hardness, Nanoscratch, Cohesion)
- Buehler Microindenter
- Hi-Temp Pin-on-Disc
- G65 – Dry Sand Abrasion
- Bruker D8 Discoverer (XRD with GADDS)
- JEOL 6490LV SEM (with EDX)

Contact

NDSU Center for Surface Protection - Soft Coatings 701-231-6219
NDSU Center for Surface Protection - Hard Coatings 701-231-5275

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