IPRIME History

• CIE (Center for Interfacial Engineering)
  – Funded by NSF from 1988 to 1999
  – Industrial outreach, 114 resident fellows, 393 PhDs
  – Fostered culture of integrated research, education and industrial interaction

• Members encouraged continued collaboration

• IPRIME (Industrial Partnership for Interfacial and Materials Engineering)
  – Legacy organization from CIE
Highly Interdisciplinary (45 faculty in 9 departments)
- Biochemistry, Molecular Biology and Biophysics
- Bioproducts and Biosystems Engineering
- Chemical Engineering and Materials Science
- Chemistry
- Physics
- Mechanical Engineering
- Biomedical Engineering
- Electrical and Computer Engineering
- Pharmaceutics

“Knowledge is one. Its division into subjects is a concession to human weakness.”
- Halford Mackinder

Research is Pre-Competitive and Non-Proprietary

Focus on fundamental science that underlie industrial products and processes

7 Interdisciplinary Research Programs
7 Research Programs

- Biocatalysis and Biotechnology (BB)
- Biomaterials and Pharmaceutical Materials (BPM)
- Coating Process Fundamentals (CPF)
- Electronic Materials and Devices (EMD)
- Flexible Electronics and Photovoltaics (FEP)
- Microstructured Polymers (MP)
- Nanostructural Materials and Processes (NMP)
Members Across the Globe

**Europe**
- France (1) Total
- Netherlands (1) DSM
- Germany (2) BASF, Evonik

**China (1)**
- Wanhua Chemical

**Japan (2)**
- Asahi Kasei
- Dai Nippon Printing

**Johannesburg, South Africa (1)**
- Sappi

**Saudi Arabia (1)**
- SABIC
Industrial Support

Contributions over $1,500,000 per year from 40+ companies

• **Sponsor Membership** ($50,000 per year)
  - Participation in up to 4 research programs
  - Opportunity to utilize Industrial Fellow Program
  - Representative on the Policy and Planning Board (PPB)

• **Affiliate Membership** ($40,000 per year)
  - Participation in one research program, no Industrial Fellow

• **Small company option**
  - $7,500 minimum or
  - 0.03% of sales per year, up to $40,000
Why IPRIME?

• Partnership
• Future employees
• Facilities
• Knowledge Transfer
Partnership

Companies

• Scientific exchange with academic sector
• Influence research directions
• Leverage government funding (NSF, NIH, DOE)
• Portal/referral to other U resources/capabilities
• Industrial Fellows

Faculty & Students

• Ready source of “hard problems”
• Funding support
• Technology implementation
• Fosters faculty interactions
• Industrial Fellows
<table>
<thead>
<tr>
<th>Company</th>
<th>Employee</th>
<th>Research Topic</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asahi Kasei</td>
<td>Ryo Katayama</td>
<td>Effect of Drying Conditions on Particle Distribution</td>
<td>Lorraine Francis/ Satish Kumar</td>
</tr>
<tr>
<td>Boston Scientific</td>
<td>Greg Sherwood</td>
<td>High sensitivity alpha-particle detectors</td>
<td>Steve Koester</td>
</tr>
<tr>
<td>Dai Nippon Printing</td>
<td>Koichi Nakano</td>
<td>Coating flow of non-Newtonian liquid in tensioned-web-over-slot die coating</td>
<td>Lorraine Francis/ Satish Kumar</td>
</tr>
<tr>
<td>Ecolab</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Evonik Industries</td>
<td>Alex Todd</td>
<td>Synthesis and self-assembly of model semi-crystalline block polymers</td>
<td>Marc Hillmyer</td>
</tr>
<tr>
<td>Interplastic Corp.</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Valspar</td>
<td>Tessie Ewert</td>
<td>Film Formation and Stress Development</td>
<td>Lorraine Francis</td>
</tr>
<tr>
<td>Wanhua Chemical</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>
Future Employees

Companies

• Early access to PhD students
• Most graduates work at IPRIME companies

Faculty & Students

• Early student access to employers
• Learn industrial research process and interactions
• Hone communication skills
• Resumes distributed

Annual Meeting Poster Session
Supporting Facilities

Companies

• CharFac* (training + analysis)

• Imaging Center*

• Polymer Characterization Facility* (rheology)

• Polymer Synthesis

• Coating Process and Visualization Lab

• Tissue Mechanics*

Faculty and Students

• In-kind equipment contributions

• Industrial utilization of facilities

*Discount for IPRIME members
Characterization Facility

- ~$20 million of equipment (replacement value):
  - 10 Electron microscopes (6 TEM, 4 SEM; analytical/cryo)
  - 11 X-ray scattering (8 wide-, 3 small-angle, 2 micro, T)
  - 9 proximal nanoprobes (4 AFM, profilometer, 4 indentors)
  - Surface analytical (XPS, Auger, micro-contact angle)
  - Chemical spectro/microscopy (3D Raman, FTIR)
  - Thin film analysis (RBS w/PIXE/FReS, spectro. ellipsom.)
- 13 scientific professionals (not students)
- ~600 research users/yr, ~120 external
- 130 faculty users from ~30 UMN departments/units
- ~250 students/yr in curricular classes & short courses
- ~50 companies per year (users/clients)
- ~20 external academic institutions per year

www.charfac.umn.edu

Other facilities on campus:
- Time-resolved TEM/spectroscopy
- Electronic/Magnetic measurements
- High-end light microscopy (superresolution, etc.), Rheology/DSC/TGA, NMR, Mass spectrom., X-ray tomography
- Micro-/Nano-fabrication, Bioprocessing (fermentation, etc.)
CharFac Instrumentation

Blue: New or upgraded within last ~4 years

Scanning and Transmission Electron Microscopes (10)
JEOL 6500 FE-SEM (BS, EDS, EBSD, cathodoluminescence)
JEOL 6700 FE-SEM (high-resolution)
Hitachi SU8220 FE-SEM (ThermoNoran EDS, high-res., cryo, BS/mix)
Hitachi S-4700 FE-SEM (cryo, BS)
JEOL 1200 TEM (bio)
FEI Tecnai G2 Spirit Bio-Twin (cryo/bio) + iCorr fluorescence LM
FEI T12 TEM (EDS)
FEI Tecnai G2 F30 FEG-TEM (EF-TEM, cryo/bio, 2-axis tilt for tomog.)
FEI Tecnai G2 F30 and Titan aberration-corrected FEG-TEMs (EDX, EELS, STEM, HAADF,...)

Two full suites of specimen prep tools (SEM/TEM; also AFM/Raman) for hard and soft materials, biological; two cryomicrotomes

Proximal nanoprobes: AFM, nanoindentors & related (9)
Two Bruker Nanoscope V Multimode 8’s (PeakForce QNM, EFM, MFM, KPFM, FMM, force volume), nPoint closed loop scanner
Two Keysight 5500’s; closed loop scanners; inverted light microscope; current sensing, T, RH control, easy fluid cells; multifrequency modes
Digital pulsed force mode add-on, LabView and custom methods developed in-house: setpoint ramping, shear modulation
Anasys nanoTA2 + SThM: heated tip methods
Hysitron Triboindentor, Picoindentor (inside TEM), Triboscope
KeysightNanoindentor XP (oscillatory loading, storage/loss)
Custom-built micromechanical tester (MMT)
Tencor stylus profilometer (up to 14” wide, 2” thick samples)

Visible light analysis & imaging
Woollam Spectroscopic Ellipsometer (film thickness and optical constant characterization over \(\lambda=200-1100\) nm)
Nikon light microscope - bright/dark field, polarization, phase, fluorescence, differential interference contrast (DIC)

X-ray Diffraction & Scattering (11)
Bruker AXS (Siemens) D5005 XRD
Siemens D500 X-Ray XRD (multi-sample changer)
Scintag XDS 2000 Theta-Theta XRD; broad temperature control
Bruker AXS microdiffractometer with 2D detector
Pananalytical X’pert Pro high-angular resolution XRD
Bruker D8 Advance XRD with temperature and humidity control
Bruker D8 Discover 2D microdiffractometer
Laue diffractometer (crystal orientation)
2D SAXS, 2 meter line
2D SAXS, 6 meter line; in-line DSC, rheometer, mechanical strain, temp. stage
SAXSess (simultaneous wide- and small-angle detection)

Ion Beam Analysis (elemental composition, depth profiles)
Rutherford backscattering (RBS); FReS, PIXE/PIGE, NRA
NEC 5.1 MeV accelerator, He\(^+\), He\(^++\) and H\(^+\) beams
Goniometer, channeling : depth/element-specific crystallinity

Surface analytical (elemental, chemical) & depth profiles
X-ray photoelectron spectrometers (XPS/ESCA) (one with UPS, new in 2016), monochromated/small spot/angle resolved (SSI)
Auger spectroscopy (AES; scanning and depth profiling)
Micro contact angle system with high-speed camera (dynamic)

Vibrational spectroscopy (chemical, 3D imaging)
Thermo FTIR spectrometer (DTGS and MCT detectors), Transm., Refl., ATR, DRIFTS; FTIR microscope
Witec confocal Raman spectrometer/microscope; full spectroscopic imaging in XY and XZ; 532-nm and 785-nm lasers with dedicated spectrometers; down to 30 cm\(^{-1}\) vibrations

(not shown: ~30 ancillaries & specimen prep tools)
13 professionals (10.65 FTE) manage 3-site capabilities. Includes expert analytical services, methods development, collaboration, education/training, assistance/consultation.

CharFac Technical Staff (10 FTE)

Chris Frethem
Dr. Javier Garcia-Barriocanal
Dr. Bob Hafner
Dr. Greg Haugstad
Dr. Han Seung Lee (0.5 FTE)
Dr. Bing Luo
Dr. Jason Myers
Dr. John Nelson (0.1 FTE)
Dr. Geoff Rojas
Dr. Nick Seaton
Dr. Seema Thakral (0.6 FTE)
Dr. Wei Zhang (0.45 FTE)
Fang Zhou

SEM (cryo and bio/soft material emphasis)
XRD, Small-angle X-Ray scattering, IBA, ellipsometry
High-contrast and cryo TEM (bio, soft materials)
AFM, Ion beam analysis (IBA: RBS, PIXE, FReS & related), XPS
SEM/TEM (cryo emphasis)
Confocal Raman/FTIR, XPS/Auger, micro-contact angle
FEG-TEM (HR/STEM/EDS/EELS), FIB
Nano/micro-mechanical, profilometry
Auger/XPS, STM/AFM, TEM
Materials SEM, EDS/EBSD/cathodoluminescence
XRD, Small-angle X-Ray scattering
Cryo FEG-TEM, 3D reconstruction, tomography
Bio EM specimen prep, (cryo)microtomy, TEM (bio, soft material)

Contact Information at www.charfac.umn.edu/staff
Knowledge Transfer

**Annual Meeting** *(May 30-June 1, 2017)*
- Workshops
- Program Reviews
- Two-Night Poster Session
- Plenary Luncheon
- TAC & PPB Meetings

**Mid-Year Workshops** *
- January 10-11, 2017

**Website with members-only features** *
- Webcasts, Research Information, Exclusive Presentations

**Short Courses** *(member discounts)*
- Coating Process Fundamentals (May, 2017)
- Rheological Measurements (June)
- CharFac Workshop and Demonstrations (August 2017)

**Industrial Fellows** *(non-proprietary) & Special Projects** *(proprietary research)*
2016
May 31-June 2, 2016

Annual Meeting Workshops:
• High Performance Polyolefins (MP)
• Surface Treatment, Surface Patterning, and Coating Adhesion (CPF)
• Web-Based Tools for Protein Engineering (BB)
• Advances in Hybrid Organic-Inorganic Materials for Flexible Electronics (FEP)
• Recent Advances in Hard Biomaterials (BPM)

Mid-Year Workshops
January 12-13, 2016
• Additive Manufacturing/3D Printing
• Frontiers in Nanoscale Spectroscopy

Short Courses
• Coating Process Fundamentals Short Course (May 24-25, 2016)
• CharFac Workshop (August 2017)

2017 Save the Dates!

2017 Annual Meeting
May 30-June 1, 2017

Mid-Year Workshops
January 10-11, 2017
• “Color and Appearance of Coatings” CPF
• “Nanomaterials for Protein, Genetic Material, and Small Molecule Delivery to Cells” NMP/BPM

Short Courses
• Coating Process Fundamentals Short Course (May 23-25, 2017)
• CharFac Workshop (August 2017)

Mid-Year Workshops
January 12-13, 2016
• Additive Manufacturing/3D Printing
• Frontiers in Nanoscale Spectroscopy

Short Courses
• Coating Process Fundamentals Short Course (May 24-26, 2016)
• Rheology Short Course (June 19-24, 2016)
• CharFac Workshop (August 29-30, 2016)
Home

Learn About IPRIME

Welcome to IPRIME

IPRIME focuses on creating opportunities for professionals in industry to collaborate with students and researchers at the University of Minnesota. This exchange provides a productive environment for addressing key areas in interfacial and materials science.

IPRIME Overview

News & More

Upcoming Events

Save the Date!
7 Research Programs

• Biocatalysis and Biotechnology (BB)
• Biomaterials and Pharmaceutical Materials (BPM)
• Coating Process Fundamentals (CPF)
• Electronic Materials and Devices (EMD)
• Flexible Electronics and Photovoltaics (FEP)
• Microstructured Polymers (MP)
• Nanostructural Materials and Processes (NMP)
# Biocatalysis and Biotechnology (BB)

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Department</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ping Wang*</td>
<td>BBE</td>
<td>Enzymology and biocatalysis, bioconversion and biosynthesis, biomaterials and functional coatings, bioelectrochemical processing, biosensors.</td>
</tr>
<tr>
<td>Mark Distefano</td>
<td>Chem</td>
<td>Organic and biochem., protein conjugates for therapeutic and biotechnology applications.</td>
</tr>
<tr>
<td>Mikael Elias</td>
<td>Biochem</td>
<td>Protein engineering and evolution, molecular modelling and recognition, bioremediation and quorum quenching strategies.</td>
</tr>
<tr>
<td>Wei-Shou Hu</td>
<td>CEMS</td>
<td>Systems biotechnology, biochemical engineering, cell culture bioprocessing, stem cell technology</td>
</tr>
<tr>
<td>Romas Kazlauskas</td>
<td>Biochem</td>
<td>Biocatalytic synthesis of chemical intermediates and biofuels, enzyme modification for new reactions.</td>
</tr>
<tr>
<td>Lawrence Wackett</td>
<td>Biochem</td>
<td>Enzymes in biotechnology, immobilization technology, bioremediation, computer prediction tools for biocatalysis</td>
</tr>
<tr>
<td>Kechun Zhang</td>
<td>CEMS</td>
<td>Synthetic biology, metabolic engineering, protein engineering, biofuels, renewable chemicals.</td>
</tr>
</tbody>
</table>

*Program Leader (Email: ping@umn.edu; Phone: 612-624-4792)

Chemical and fuel bioprocessing; Biocatalyst engineering; Biotransformation and Bioremediation; Enzyme evolution; Bio-based polymers and biocoatings; Pathway engineering; Synthetic biology; Systems biotechnology; Cell culture bioprocessing
## Biomedical and Pharmaceutical Materials (BPM)

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Department</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ron Siegel*</td>
<td>Phm¹/BME²</td>
<td>hydrogels, drug delivery systems, microfabrication</td>
</tr>
<tr>
<td>Effi Kokkoli</td>
<td>CEMS³</td>
<td>bioadhesion and drug targeting</td>
</tr>
<tr>
<td>Jayanth Panyam</td>
<td>Phm</td>
<td>multifunctional nanodelivery vehicles</td>
</tr>
<tr>
<td>Wei Shen</td>
<td>BME</td>
<td>bioactive materials</td>
</tr>
<tr>
<td>Calvin Sun</td>
<td>Phm</td>
<td>drug crystal and particle engineering</td>
</tr>
<tr>
<td>Raj Suryanarayanan</td>
<td>Phm</td>
<td>solid state properties of drugs, stability of drug/biomaterial formulations</td>
</tr>
<tr>
<td>Bob Tranquillo</td>
<td>BME/CEMS</td>
<td>fabrication and characterization of bioartificial cardiovascular replacement tissues</td>
</tr>
<tr>
<td>Chun Wang</td>
<td>BME</td>
<td>bio-molecular materials, polymer-based DNA and drug delivery, protein-based tissue scaffolds</td>
</tr>
</tbody>
</table>

*Program Leader (Email:siege017@umn.edu)*

Affiliated Investigators: *Chris Macosko, Marc Hillmyer, Theresa Reineke, Tom Hoye,*

Pharmaceutics; Biomedical Engineering; Chemical Engineering and Materials Science, Chemistry

- Biomaterials for drug delivery, medical device coatings, and tissue engineering
- Drug/medical device combinations, characterization of drug/materials interactions
- Cell-based fabrication of bioartificial tissues
- Novel tissue mechanical testing and analysis methods
## Coating Process Fundamentals — CPF

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lorraine F. Francis*</td>
<td>Solidification, stress development, microstructure, printing</td>
</tr>
<tr>
<td>Satish Kumar*</td>
<td>Transport processes, interfacial phenomena, microfluidics</td>
</tr>
<tr>
<td>Marcio S. Carvalho**</td>
<td>Fluid mechanics, rheology, numerical methods</td>
</tr>
<tr>
<td>Alon V. McCormick</td>
<td>Curing, thermodynamics &amp; kinetics, NMR, stress development</td>
</tr>
<tr>
<td>C. Daniel Frisbie</td>
<td>Printing processes, printed electronics</td>
</tr>
<tr>
<td>Chris W. Macosko</td>
<td>Rheology, polymer processing</td>
</tr>
<tr>
<td>Xiang Cheng</td>
<td>Colloids, polymers, rheology, visualization</td>
</tr>
<tr>
<td>Michael Tsapatsis</td>
<td>Zeolite and particulate coatings, membranes, separations</td>
</tr>
<tr>
<td>Wieslaw Suszynski***</td>
<td>Coating process experiments, apparatus, flow visualization</td>
</tr>
</tbody>
</table>

*Program Co-Leaders*

**Pontifica Universidade Catolica, Rio de Janeiro**

***Research Engineer and Coating Process and Visualization Laboratory Manager***
# Electronic Materials and Devices (EMD)

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Department</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steven Koester*</td>
<td>ECE</td>
<td>Electronic devices, semiconductors</td>
</tr>
<tr>
<td>Bharat Jalan*</td>
<td>CEMS</td>
<td>Complex oxides, molecular beam epitaxy</td>
</tr>
<tr>
<td>Steve Campbell</td>
<td>ECE</td>
<td>Thin-film photovoltaics, 2D materials</td>
</tr>
<tr>
<td>Paul Crowell</td>
<td>Physics</td>
<td>Magnetism, transport, ultra-fast spectroscopy</td>
</tr>
<tr>
<td>Dan Frisbie</td>
<td>CEMS</td>
<td>Organic electronics, electrolyte gating</td>
</tr>
<tr>
<td>Chris Leighton</td>
<td>CEMS</td>
<td>Electronic/magnetic properties, film/layer growth</td>
</tr>
</tbody>
</table>

**Collaborators**

Andre Mkhoyan (CEMS), Xiaodong Xu (U. Washington), Ludwig Bartels (UCR), Chris Palmstrøm (UCSB), Chris Kim (ECE)

* Co-Program Directors

Synthesis, structural and chemical characterization of materials relevant for a wide range of electronic, optical and magnetic devices. Particular emphasis is placed on the understanding of the fundamentals of electronic structure and transport in electronic and magnetic materials, in addition to the materials science, physics and chemistry of the interfaces and nanostructures that play a vital role in device operation.
<table>
<thead>
<tr>
<th>Investigator</th>
<th>Department</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russell Holmes*</td>
<td>CEMS</td>
<td>Thin films, LEDs, solar cells</td>
</tr>
<tr>
<td>David Blank</td>
<td>CHEM</td>
<td>Ultrafast optical spectroscopy</td>
</tr>
<tr>
<td>Chris Douglas</td>
<td>CHEM</td>
<td>Molecular synthesis</td>
</tr>
<tr>
<td>C. Daniel Frisbie</td>
<td>CEMS</td>
<td>TFTs and printed electronics</td>
</tr>
<tr>
<td>Paul Ruden</td>
<td>ECE</td>
<td>Device modeling, transport theory</td>
</tr>
</tbody>
</table>

*Program Leader

Interested in the design of materials, device architectures, and processes
For the realization of flexible electronics and optoelectronics
based on organic and hybrid organic-inorganic materials
# Microstructured Polymers (MP)

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Department</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frank S. Bates *</td>
<td>CEMS</td>
<td>Thermodynamics, scattering, synthesis</td>
</tr>
<tr>
<td>Kevin Dorfman</td>
<td>CEMS</td>
<td>Modeling, confined polymers, DNA</td>
</tr>
<tr>
<td>Chris Ellison</td>
<td>CEMS</td>
<td>Composites, thin films, lithography fibers, photopolymerization, &amp; polymer processing</td>
</tr>
<tr>
<td>Marc A. Hillmyer</td>
<td>CHEM</td>
<td>Polymer synthesis and characterization (Director: Polymer Synthesis Facility)</td>
</tr>
<tr>
<td>Timothy P. Lodge</td>
<td>CHEM/CEMS</td>
<td>Polymer dynamics, solutions, scattering</td>
</tr>
<tr>
<td>Chris Macosko</td>
<td>CEMS</td>
<td>Rheology, processing</td>
</tr>
<tr>
<td>Mahesh Mahanthappa</td>
<td>CEMS</td>
<td>Polymer Science and Engineering</td>
</tr>
<tr>
<td>David C. Morse</td>
<td>CEMS</td>
<td>Theory and modeling</td>
</tr>
<tr>
<td>Theresa Reineke</td>
<td>CHEM</td>
<td>Biomedicine, Diagnostics, Targeted Delivery</td>
</tr>
</tbody>
</table>

*Program leader

Collaborators include:
Lorraine Francis (CEMS), Dan Frisbie (CEMS), Tom Hoye (CHEM), Chris Leighton (CEMS), Ron Siegel (PHRM), Bill Tolman (CHEM)

Synthesis, characterization, dynamics, processing, properties, and theory
## Nanostructural Materials & Processes (NMP)

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Dept</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alon McCormick*</td>
<td>CEMS</td>
<td>Reaction Engineering of Materials Synthesis; Spectroscopy; Molecular Simulation</td>
</tr>
<tr>
<td>C. Daniel Frisbie</td>
<td>CEMS</td>
<td>Molecular Materials and Interfaces; Molecular Electronics</td>
</tr>
<tr>
<td>Wayne Gladfelter</td>
<td>CHEM</td>
<td>Materials Chemistry; Inorganic Chemistry; Scanning Probe Microscopy</td>
</tr>
<tr>
<td>Greg Haugstad</td>
<td>CHAR FAC</td>
<td>AFM Scanning Probe Microscopy (Director, Characterization Facility)</td>
</tr>
<tr>
<td>Christy Haynes</td>
<td>CHEM</td>
<td>Porous and plasmonic nanomaterials, nanoparticle toxicity</td>
</tr>
<tr>
<td>R. Lee Penn</td>
<td>CEMS</td>
<td>Environmental Solid State Chemistry</td>
</tr>
<tr>
<td>Andreas Stein</td>
<td>CHEM</td>
<td>Solid State Chemistry of Porous Materials</td>
</tr>
<tr>
<td>Michael Tsapatsis</td>
<td>CEMS</td>
<td>Materials Synthesis, Structure Elucidation and Modification</td>
</tr>
<tr>
<td>Joe Zasadzinski</td>
<td>CEMS</td>
<td>Molecular Fluids, Optical/Electron/Scanning Probe Microscopy</td>
</tr>
</tbody>
</table>

### Associated Investigators:
- Frank Bates
- Lorraine Francis
- Bill Gerberich
- David Norris
- Wei Zhang
- Christy Haynes

Synthesis, phase behavior, structure, and performance of surfactants and self-assembled molecular and colloid systems

* Program Leader