Enhanced Oil Recovery and Water Management

**Enhanced Oil Recovery Methods**
- Conformance control to reduce water production using preformed particle gels.
- Chemical EOR methods, including polymer flooding, polymer-surfactant flooding, MEOR (biosurfactant), and Wettability alteration for carbonate reservoirs.
- CO$_2$ and CO$_2$ foam flooding

**Multiple Phase Flow in Unconventional Resources**
- Characterize Fluid flow behavior using micro- and nano-fluidic chips
- Characterize shale and tight gas rocks

**Geological Carbon Storage**
- Develop methods to improve carbon storage efficiency in mature oilfields.
- Develop methods to maintain wellbore integrity and control leakage.

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**Funding**
- Department of Energy, ACS Petroleum Research Fund, PetroChina, Conoco-Philips, Occidental Company, New Wantong Oilfield Chemicals

**Recognitions**
- SPE Mid-Continent North America Regional Distinguished Achievement Award for Petroleum Engineering Faculty

**Keywords**
- Water management, Enhanced Oil Recovery (EOR), Conformance Control, Hydrogel, Particle Gels, Unconventional, Multiphase Flow, Nano-fluidics

**CEC Research**

**Novel Particle Gels for Extremely Heterogeneous Reservoir Conformance Control**
Enhancing oil and gas recovery from existing reservoirs while protecting environments by developing new recovery methods and/or removing current technical bottlenecks.
Secure and Smart Cyber-Physical Systems

Cyber-Physical Systems (CPS)

- Large complex distributed Critical Infrastructures
- Ensure correctness through distributed invariant monitoring

Security

- Mitigate cyber-physical attacks
- Determine a unified cyber-physical information flow model to determine potential attack vectors

Smart Living

- Develop Sustainable Cyber-Physical living environments
- Develop Privacy and Security for smart living environments

Keywords

- #CyberPhysicalSecurity, #Information Assurance, #SmartLiving, #Invariants, #CriticalInfrastructure

Recognitions

- OpEd: Moving beyond medieval cybersecurity, St. Louis Post Dispatch, Oct 30, 2015
- IEEE Computer Society Board of Governors

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Funding

- National Science Foundation, National Institute of Standards and Technology
Infrastructure Renewal and Sustainable Materials for Civil Engineering Applications

**Structures / High Performance Concrete Materials**
- High strength concrete (HSC), High strength-self consolidating concrete (HS-SCC), Ultra high performance concrete (UHPC), High volume fly ash concrete (HVFAC).

**Fiber-Reinforced Polymers (FRP) in Structural Applications**
- FRP, Fiber reinforced cementitious matrix (FRCM), Steel reinforced polymers (SRP), Hybrid composite systems.

**Structural Health Monitoring and Load Testing of Bridges**
- Use and implementation of sensors for monitoring and load testing including vibrating wire strain gauges, thermistors, LIDAR, and high precision surveying systems.

**Structural Hardening and Blast Mitigation**
- Development of systems for blast mitigation and structural hardening.

**Use of advanced composites for rehabilitation and new material development for sustainable construction**

**Keywords**
- #HPC, #HSC, #HS-SCC, #UHPC, #HVFAC, #FRP, #FRCM, #SRP, #SHM, #Blast Mitigation, #Infrastructure Renewal, #Rehabilitation.

**Recognitions**
- Award: ASCE Professional Recognition Award, 2014.
- Award: ACI EAC Committee Member of the Year Award, 2010.
- Award: Society of Military Engineers (SAME) Award, 2010.
- Fellow: ACI, ASCE, TMS.

**Funding**
- US Department of Transportation, Federal Highway Transportation, Missouri Department of Transportation, National Science Foundation, Air Force Research Laboratory, Department of Homeland Security, Army Research Laboratory.

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**CEC Research**
Glass Science and Technology

Spectroscopic Studies of Glass Structure
• Utilize many tools, including Raman, NMR spectroscopies, neutron and x-ray diffraction techniques, to characterize the molecular-level structures of oxide glasses

Corrosion Studies of Glass
• Characterize and model interactions between oxide glasses and aqueous environments to develop new compositions for a variety of applications, including bioactive glasses and glasses for nuclear waste encapsulation

Designing Glasses for Engineering Applications
• Developing oxide glass compositions that can be used to seal solid oxide fuel cells, apply as protective coatings for metals, used as optical filters or substrates, processed using additive manufacturing techniques, etc.

Aging and Fatigue Studies of Glass
• Use mechanical tests and surface characterization tools to understand how environment controls glass strength

PoC: Richard K. Brow, Interim Dean, College of Engineering and Computing Curators’ Distinguished Professor, Materials Science and Engineering brow@mst.edu; http://mse.mst.edu/faculty/staffandfacilities/brow/

Recent Funding
National Science Found, Dept of Education, Dept of Energy, Lawrence Livermore Lab, Sandia National Labs, PPG Ind.

Keywords
• #GlassScience, #Corrosion, #Bioglass, #GlassStructure, #WasteVitrification, #OpticalGlass, #SealingGlass

Recognitions
Award: 2016 N.F. Mott Award, J. Non-Cryst. Solids
Award: 2004 George W. Morey, glass science
Service: 2012-13 President of the American Ceramic Society
Fellow: American Ceramic Soc., Soc. Glass Technology (UK)

Relate composition to atomic structure in order to design new glasses for engineering applications