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# C O N T E N T S

	Page
Message from the Chairman.....	1
Region and Campus.....	2
The University.....	2
Library	
Information Technology	
Counseling and Academic Support	
Programs	
Music and Fine Arts	
Career Opportunities Center	
Housing	
Recreation/Sports Facilities	
Department of Chemistry.....	5
Instrumentation	
Research Facilities.....	7
Graduate Center for Materials Research	
Missouri S&T Coatings Institute	
Center for Environmental Science	
and Technology	
Assistantship and Fellowship	
Opportunities	
Degree Programs.....	9
Doctor of Philosophy	
Master of Science	
With Thesis	
Without Thesis	
Faculty.....	10
Emeritus and Adjunct Professors.....	29
Graduate Courses.....	32
Application Procedure.....	35

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# GRADUATE STUDY IN CHEMISTRY

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Dear Prospective Student:

Choosing a graduate school is one of the most important decisions you will make. At stake are not only the next few years of your life but also the future success of your career.

A message from  
the Chairman

Your choice should be based on the quality, prestige and recognition of the graduate program in chemistry. The success of former graduate students is also important. Our emphasis on excellence in research and creativity has

moved our graduate program to the forefront of science. There is a strong demand for our graduates.

You may already know which areas of chemistry interest you most: analytical, inorganic, organic or physical. If not, the beginning graduate courses provide an excellent means of identifying your area of specialization. We offer programs leading to advanced degrees in traditional areas, and in other emerging areas such as materials science, polymers, environmental science, geo-, bio- and radiochemistry.

Most of our graduate students find that graduate education is more personally rewarding than was their undergraduate training. As an undergraduate, you learned the currently accepted explanations for observations chemists make in the laboratory. In your graduate studies at Missouri University of Science and Technology, your ability to memorize "facts" will be less important. Your ability to conceive, design and perform experiments or computations to test new theories or previous explanations will be more important.

The combination of a natural love for science with an exciting research project will make your stay at Missouri S & T both enjoyable and productive. Experience has shown that creative happiness and research productivity are inseparable. We will therefore be working with you to make your stay here personally gratifying and productive.

If you would like to visit our department, please call or email us and we will be happy to arrange for you to tour our facilities and meet the faculty members and students of your choice.



Sincerely,

A handwritten signature in black ink, appearing to read "P. Whitefield".

Philip D. Whitefield, Chairman  
and Professor of Chemistry

# REGION AND CAMPUS

Missouri S & T is located in Rolla, Missouri, a town of about 15,000 in the wooded rolling hills of the Missouri Ozarks. In Rolla, you'll find a friendly, small-town atmosphere within 100 miles of the St. Louis and Springfield metropolitan areas. It also is about a one-hour drive from the state capital, Jefferson City, and the Lake of the Ozarks.

Many recreational activities, particularly canoeing, hiking, swimming, fishing, and spelunking can be enjoyed within a short drive from Rolla. The combination of easy access to outdoor activities and major metropolitan areas makes Rolla an attractive place to live. Living costs, particularly housing and services, tend to be less expensive than in larger urban areas.



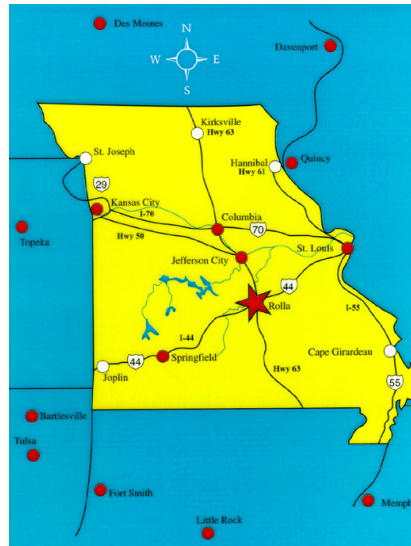
## THE UNIVERSITY

The Missouri University of Science and Technology is the location of one of the four University of Missouri campuses -- with others at Columbia, Kansas City, and St. Louis.

The University of Missouri has a long and proud history. It was established at Columbia in 1839, only 18 years after Missouri became a state. It is a land-grant university and is recognized as the first state university west of the Mississippi River. It is also a member of the American Association of Universities.

In 1870 the Missouri School of Mines and Metallurgy (MSM) was established at Rolla. On July 1, 1964, MSM was renamed as the University of Missouri-Rolla (UMR). On January 1, 2008 UMR became Missouri University of Science and Technology and since its beginning has maintained its traditional strengths in science and engineering.

Missouri S&T has an enrollment of about



5,000 students, including about 560 masters candidates and 300 doctoral candidates. Approximately 95% of these students major in science and engineering.

The master of science (M.S.), doctor of philosophy (Ph.D.), doctor of engineering, and professional development degrees are offered along with bachelor's degree programs.

The Missouri S&T campus encompasses about 284 acres and combines both old and new architecture. Many new buildings have been constructed in the past several years.

Missouri S&T is large enough to provide the specialized equipment necessary for state-of-the-art experimentation yet small enough to provide close contact between students and faculty.

## *Wilson Library*

Wilson Library serves as a gateway to an ever-expanding world of information. A growing collection of books, periodicals, audiovisual materials and computer-based resources supports research and learning and provides entertainment as well. Most electronic resources are available 24/7 from any computer on campus, at home or in the dormitories. Students find the library a pleasant place to study, a central meeting place for study groups and sometimes just a comfortable place to socialize and relax!

The Missouri S&T library houses more than 450,000 volumes and currently subscribes to over 850 periodical titles.

These print resources are supplemented by a variety of other materials, including electronic journals, CDs, and videos. The collection is augmented by the existence of a shared catalog that allows users to request

items from other Missouri colleges and by an active interlibrary loan department that is able to borrow or obtain copies of most materials needed by Missouri S&T students and faculty.

Many library resources are accessible over the Internet. The library web page provides access to the catalog and a number of databases, including SciFinder Scholar. Workshops on library resources are offered on a regular basis, and librarians are available by appointment for specialized assistance. For more information, people are encouraged to explore the library home page at <http://library.mst.edu>.

## *Missouri S&T Information Technology (IT)*

### Getting Started



Information Technology (IT) provides a variety of computing tools and resources to assist with academic and administrative work done at Missouri S&T.

Most faculty, staff and students use computers daily to help with tasks such as these: to register for classes, communicate with friends using e-mail, collaborate on group projects and research, publish web pages, write reports and find course schedules just to name a few.

### Computer Accounts

Computer accounts are assigned to students and are used to access various resources at Missouri S&T, such as the computing network and the computers and software in Technology Classrooms (TC). Most Missouri S&T IT services require an authorized computer account (user id and password) to gain access. The following services are available through IT computer accounts.

### E-mail

Network file storage  
Access to the campus network

New computer accounts can be activated by visiting the Solution Center web page at [helpdesk.mst.edu](http://helpdesk.mst.edu) and clicking the "New Students" link.

## Leaving Missouri S&T

Assigned computer accounts remain active and available for use as long as the assignee is enrolled in classes at Missouri S&T. Additional information regarding computer accounts may be found at [it.mst.edu/policies/umr/account.html](http://it.mst.edu/policies/umr/account.html). Before leaving Missouri S&T, all pertinent documents and files should be saved and removed from computer accounts to avoid data loss. Also, e-mail should be archived and then forwarded. For complete details, see the IT student handbook at [helpdesk.mst.edu/documents/StudentITHandbook.pdf](http://helpdesk.mst.edu/documents/StudentITHandbook.pdf).

## Systems and Software

Missouri S&T IT provides a wide variety of computing and networking facilities and support. These facilities include, but are not limited to the following:

- PCs
- MACs
- Linux systems

## General Purpose Cluster computing

Please contact Missouri S&T IT at 573-341-HELP for more information on General Purpose Cluster computing or for assistance in locating specific software.

## Technology Classrooms

Technology Classrooms (TCs) are computing sites provided to support academic computing and teaching methodologies. More than 40 TCs are located in various buildings around campus. Use of computers in these locations is restricted to Missouri S&T faculty, staff and students.

## Privileges and Responsibilities

Missouri S&T IT provides access to computing, networking and information resources in support of teaching, research and other official duties of the university. Access to the computing resources and facilities is a privilege, not a right. The "Missouri S&T Computing and Network Facilities Acceptable Use Policy" describes the ethical and legal responsibilities regarding computing resources.

Other computing policies and procedures, including the Missouri S&T policies, can be found at [helpdesk.mst.edu/generalinfo/networkstorageindex.html](http://helpdesk.mst.edu/generalinfo/networkstorageindex.html).

## Individually Owned Computers

Missouri S&T IT in conjunction with the Missouri University of Science and Technology Bookstore provides recommendations for supported hardware and software to those wishing to purchase for personal use.

Academically priced software for personally owned computers may be purchased at the Missouri S&T Bookstore. Software on university owned machines is provided through licensing agreements with various vendors.

IT provides Microsoft Outlook to students free of charge on the "Get Connected CD" (available from the IT Walk-In Center, see Getting Help) and McAfee Anti-virus is available for free download at: [helpdesk.mst.edu/generalinfo/security/antivirus.html](http://helpdesk.mst.edu/generalinfo/security/antivirus.html).

Please visit [www.mstbookstore.com](http://www.mstbookstore.com) and click on the "MiNERTECH" logo for more information on supported technology and recommended systems.

## Connecting to the Network

Computers in campus residence halls and fraternities or sororities connect to the network through an Ethernet connection or via wireless connection. Wireless coverage currently extends to over 70% of the campus (including the Residential College); providing great flexibility and convenience for members of the campus community.

To register a machine on the campus network, simply plug-in to an available Ethernet jack and open a web browser, an online registration page will load, complete the online form and you are ready to access the network. Detailed instructions on connecting to the network, using either wired or wireless Ethernet, are available at [helpdesk.mst.edu/](http://helpdesk.mst.edu/); click on the "Knowledge BASE" link. Virtual Private Network (VPN) connections are available allowing members of the campus community to connect to the network while away from campus or traveling.

Special usage policies apply to network connections; see the "Policies and Procedures" web page at [it.mst.edu/policies/index.html](http://it.mst.edu/policies/index.html). In addition, Ethernet cards (both wired and wireless) and cables may be purchased through the Missouri S&T Bookstore which is located in the Havener Center.

## Getting Help

The Missouri S&T IT Solutions Center is available to assist the students, faculty and staff of Missouri S&T in using the different computing systems on campus.

Help is available on a wide range of items from the Windows-based PCs, Macintoshes

and Linux workstations to the supported software on these systems.

Members of the campus community may call 573-341-HELP or access the online Help Request system at [helpdesk.mst.edu](http://helpdesk.mst.edu).

## Internet Resources

- Online Help Request - [help.mst.edu](http://help.mst.edu)
- Missouri S&T - [www.mst.edu](http://www.mst.edu)
- Solution Center - [helpdesk.mst.edu](http://helpdesk.mst.edu)
- IT - [it.mst.edu/](http://it.mst.edu/)
- Campus Library - [library.mst.edu/](http://library.mst.edu/)
- Joe'SS - [registrar.mst.edu/](http://registrar.mst.edu/)

## Counseling and Academic Support Programs

Academic Support Programs  
203 Norwood Hall  
341-6655  
<http://learn.mst.edu/>

Academic Support Programs offers a wide variety of resources available to enhance your academic success.

The staff of Academic Support Programs provide professional consultation and assistance regarding academic motivation, attitude, and approach to the learning pro-



cess. Call to make an appointment any time of the year.

The Student Learning Center (204 Norwood) is adjacent to the Academic Support Programs office. It is a place to study and where you'll have access to a computer learning center, LEAD peer tutoring, and much more.

Resource Learning Center is located at Thomas Jefferson Hall, Room G-7, (as well as in 204 Norwood) and is a great study place where you can access old course files, a resource library, a copy machine, and computers. The convenient location

is great for residents. Who said you can't study in your PJ's!

What you'll find at Academic Support Programs office and the Student Learning Center, 203 & 204 Norwood Hall:

- Great atmosphere for studying and working with others
- LEAD peer tutoring (see schedule at <http://lead.mst.edu/assist/index.html>)
- Computer Learning Center
- Academic Support Resource Library
- Free coffee and a friendly staff
- Old student course files to use as study tools
- Study techniques and test taking strategies
- Learning consultation to discover your most effective learning style

You will also find a virtual academic support center at our website too!

Academic Support Programs operates Disability Support Services, which provides academic accommodations for qualified students. These services are designed to provide students with equal educational opportunities. Services available to qualified students can include classroom adaptation, alternative testing environment, books on tape, and assistance in overall access on campus. If you have a disability or are limited in some way, contact Disability Support Services to request accommodations. University policy and procedures can be found at <http://dss.mst.edu/pages/policy.html> or call for an appointment, 341-4211.

The Testing Center, also operated by Academic Support Programs, administers national tests like the CLEP test, GRE, Millers Analogies Test, CBASE and PRAXIS. Correspondence course testing service is also available. A range of personality, interest, and skills assessment instruments are available to assist the Counseling Center clients with personal, academic and career concerns. Students desiring to test out of courses, take a test for correspondence courses, or having any other testing needs can contact the Testing Center at 341-4222. Visit our website for more information <http://testcenter.mst.edu/>.

## Academic Assistance on Campus

Learning Enhancement Across Disciplines (LEAD) Program  
203 Norwood Hall  
341-7070  
<http://lead.mst.edu/>

The LEAD program offers learning forums for students who wish to improve their understanding of concepts and their mastery of skills in a wide variety of introductory courses to achieve their full potential.

## Learning Centers

The LEAD program sponsors open-environment Learning Centers for several large-enrollment introductory courses. Discipline-based faculty and undergraduate peer instructors staff the centers during fixed hours each week. Students are encouraged to work in interactive groups to solve problems and to develop strategies, guided and validated by the experts on duty. The centers are designed not only to help students with course content, but to also help them gain professional skills in communication, problem solving and teamwork.

## Peer Tutoring

Scheduled drop-in tutoring is available at fixed locations for a large number of introductory and foundational courses. It focuses on individual and small-group interactive assistance. The undergraduate peer tutors are accomplished in the course material, trained by professional LEAD staff and communicate with LEAD faculty mentors in the associated disciplines.

For further information about LEAD or the current semester schedule of academic assistance, call 341-7070 or check the website at <http://lead.mst.edu/>.

### Other Sources of Academic Assistance

There are several other sources of academic assistance at Missouri S&T that students can access to improve their understanding of and proficiency with course material and learning process.

- Professors
- Professors can clarify concepts or refer students to peers or resources that can provide academic assistance
- Math Help Program, Mathematics & Statistics Department, 341-4641,
- Writing Center, 113 Campus Support Facility, 341-4436, <http://writingcenter.mst.edu/>
- Counseling Center, 204 Norwood Hall, 341-4211, <http://counsel.mst.edu/>

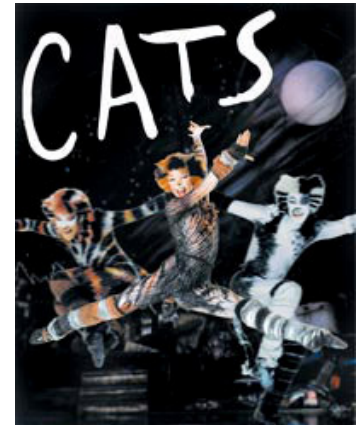
- Study skill reference material at the Van Matre Resource Center
- Library, 341-4227, <http://library.mst.edu/>

## Music and Fine Arts

Music and fine arts abound at Missouri S&T. The Student Union Board sponsors plays, lectures, films, dances, and concerts. The campus also benefits from the Campus Performing Arts Series and the Missouri S&T Film Series.

Leach Theater is a modern theater with computerized lighting and sound systems. The equipment allows the facility to support such groups as The St. Louis Symphony, Broadway Productions, Alvin Ailey Dance Ensemble and The Chinese Magic Revue. Performances also are available locally through the Ozark Actors Theatre and the Regional Opera Company.

The Remmers Special Artist/Lecture Series has brought to campus such speakers as former Secretary of State Henry Kissinger, former Prime Minister of Britain Margaret Thatcher, business journalist Louis Rukeyser, author and business consultant Thomas



J. Peters, CBS News correspondent Charles Kuralt, former CIA Director Stansfield Turner, former chairman of the U.S. Joint Chiefs of Staff Admiral William J. Crowe, former president of Costa Rica Nobel Peace Prize Winner Oscar Arias Sanchez, and former Surgeon General C. Everett Koop.

There are numerous music groups open to student participation, and you are invited to become involved in dramatic productions as a performer or an observer.

## Career Opportunities Center

The Career Opportunities Center provides many services to assist Missouri S&T undergraduate students in their professional job search for summer, cooperative training and full-time employment. Services available include:

- Registration and Interview Sign-up
- Resume and Cover Letter Workshops
- Job Search Strategies Workshops
- Interviewing Workshops
- Professional Interview Suites
- Individual Appointments
- On-Campus Interviews
- Company Literature
- Career Fairs
- Resource Library
- Industry Speakers
- Job Listings

Services are also offered to alumni for entry-level and advanced job referrals.

## Housing

Although most graduate students live off-campus, on-campus housing is also available. Graduate student housing includes residence halls for single students and apartments for single and married students with or without children.

Meal plans with several options are available for both campus and off-campus residents.

## Recreation/Sports Facilities



A busy day at the career fair

Campus sports and recreation facilities are available. Most of the facilities are housed in the Student Recreation Center and the Gale Bullman Multi-Purpose Building. These facilities include: basketball courts, a swimming pool, weight rooms, aerobic machines, an indoor jogging track, racquetball courts, a squash court, an aerobics/martial arts room and outdoors tennis courts and intramural fields. In addition, there is also a nine-hole golf course and driving range.

Canoeing (a popular activity), caving, hunting, and fishing are a short distance from Rolla.

Rolla has 219 acres of park land to enjoy. The 88-acre Ber Juan Park is home to the recently built Centre, SplashZone Water Park, a small lake, a 1.5-mile fitness trail, a skate park, sports fields, playground equipment, a picnic shelter, and acres of natural prairie. Best of all, Ber Juan Park is only blocks from downtown and campus.

Inside the Centre, one can enjoy year-round swimming! The Kiwanis Natatorium includes a leisure pool with beach-like entrance, interactive water features, lazy river, vortex, two-story water slide, kiddie slide, four lap lanes, and a heated therapy pool.

Working out has never been so enjoyable! With the latest in exercise equipment and spectacular views of the lake, the fitness area is truly an inspiring place dedicated to your well-being. Walkers and runners alike will benefit from the one-tenth mile indoor track, sponsored by Sprint.

The Centre includes a game room, on-site baby sitting service, the Castleman Lounge with a fireplace and large screen television, a group fitness studio, birthday party room, snack bar, locker rooms, and family changing rooms. The Fidelity Communications Gymnasium has cushioned wood floors and can accommodate up to three simultaneous games of volleyball or basketball. The gym can be used for indoor tennis and other activities. At least one court will be available for drop-in use most hours of operation.

Two 1,000-square-foot meeting rooms are available with amenities that include cable and Internet connections, audiovisual capabilities, and a caterer's kitchen. A retractable wall allows this space to accommodate up to 100 people banquet style. These rooms are available for rent and are ideal for business meetings, banquets, wedding receptions, and other special events.

## Department of Chemistry

When you further your education in chemistry through graduate study at Missouri S&T, you will have access to some of the finest facilities and instrumentation available. You also will work with faculty and staff who are among the best in their profession in teaching and research.

The Department of Chemistry is located in Schrenk Hall along with the Departments of Chemical & Biological Engineering and Biological Sciences. The proximity of these three departments has created many unique opportunities for interdisciplinary research and discussion. Modern teaching laboratories and excellent graduate research facilities are available within the Department. Computer facilities are located in the building which gives students access to the Missouri S&T computer system. Twenty-one full-time faculty members, including three senior investigators in the Graduate Center for Materials Research, are dedicated to teaching and research in chemistry. Graduate student enrollment in the Department is about 65 students.

The Department of Chemistry provides instructional programs in analytical, inorganic, organic, physical, polymer and biochemistry, as well as in more specialized areas. Besides the basic fields, there are programs in bio-analytical chemistry, cancer biology, colloids, corrosion, cosmochemistry, electrochemistry, environmental chemistry, molecular modeling, kinetics, organometallic chemistry, reaction mechanisms, solid-state chemistry, surface coatings, and theoretical chemistry. Interdisciplinary programs in materials science and atmospheric sciences are also available.

A number of research projects involve faculty and students from other areas of the University, including the Graduate Center for Materials Research, Rock Mechanics and Explosives Research Center, and the Departments of Ceramic Engineering, Physics, Life Sciences,



and Chemical & Biological Engineering.

## ***Instrumentation***

The instrumentation in the Department of Chemistry includes Varian and Bruker 200 and 400 MHz FT/NMR spectrometers with multinuclear liquid, diffusion, and variable-temperature capabilities; a Varian/Oxford 400 MHz solids NMR; a Bruker X-ray diffractometer with low-temperature attachment; X-ray photoelectron/Auger electron spectroscope/temperature programmed desorption (XPS/AES/TPD) ultra-high vacuum surface analysis chamber; a Hewlett-Packard 5989 mass spectrometer with gas-chromatograph and direct-insertion-probe inputs; a Hitachi M-8000 mass spectrometer with a high-performance liquid-chromatograph input; a Perkin-Elmer 2400 C-H-N elemental analyzer; a Spex 1403 laser Raman spectrometer with a coherent argon ion source; Harwell and Ranger low-temperature Mossbauer spectrometers; Beckman PACE/MDQ capillary-electrophoresis instruments with UV and laser excitation systems; an Applied Color Systems 1800 color-matching/formulating computing spectrophotometer; a TA Instruments differential scanning calorimeter; TA Instruments and Perkin-Elmer thermogravimetric analyzers; Perkin-Elmer, Par 273, and EG&G potentiostat/galvanostats; a Johnson-Matthes magnetic-susceptibility balance; a Faraday low-temperature magnetic-susceptibility balance; Nicolet Magna and Nexus FT/IR spectrometers with multiple detectors and sample attachments; and a Wyatt HPLC with Dawn EOS light-scatter-

ing detection system. The department houses an extensive collection of additional mass spectrometers. Backing up these instruments are a wide variety of additional chromatographs (GC, LC, IC), infrared spectrometers, dispersive optical spectrometers (UV/VIS, IR, AA), fluorescence/luminescence spectrophotometers, centrifugal partition chromatographs, refrigerated-ultra centrifuges, calorimeters, salt-spray chambers, and radiation counters. In addition, numerous PC/compatible,

Macintosh and UNIX computers are available in laboratories, computer learning centers, and computerized classrooms, as well as access to the campus centralized computing facility which includes numerically-intensive-computing support.

## **RESEARCH FACILITIES**

The support for research at Missouri S&T extends beyond the formal college and department structure, and the interdisciplinary nature of the activities of these organizations can provide students with experiences beyond those available within a single discipline.

Interdisciplinary research efforts which have been organized into centers or institutes include those for biochemical processing, aging studies, international studies, technology transfer and economic development, engineering research, environmental research, pyrometallurgy, cloud physics, materials research, high pressure waterjet laboratory, artificial intelligence, chemical and extractive metallurgy, applied mathematics, river studies, river and lake systems, atomic and molecular research, mining and mineral resources, rock mechanics and explosives, thin film processing, and transportation. Following are the Missouri S&T research centers and institutes with which the Chemistry Department interacts.

## ***Materials Research Center (MRC)***

The Center was established for the purpose of multidisciplinary research on materials and to provide improved centralized laboratories and specialized equipment for faculty and students involved in materials research. The Center provides graduate students in eight academic departments, including chemistry, with advanced training in materials science.

The research conducted in the Center ranges from fundamental science to applied engineering and includes the development, evaluation, application, and understanding of ceramics, metals, polymers, and composites.

Major accomplishments from the Center include: glass microspheres for treatment of liver cancer, transparent composites for windows/armor, electrodeposition of shape memory alloys, glassphalt road paving, ceramic materials (perovskites) for fuel cells, electrodeposited superlattices, electrodeposited epitaxial films, quantum-confined materials such as tunnel diodes, nanolithography, asbestos-free brake lining, new permanent magnet materials, dielectric and piezoelectric properties of normal and relaxor ferroelectric, high frequency phased linear arrays for medical ultrasound, and improved building envelope systems to withstand natural disasters.

In 1985, the past achievements and continuing importance of the Missouri S&T materials science and engineering program were acknowledged when this program was declared one of only eight areas designated for eminence in the University of Missouri-System.

The Center is located in Straumanis Hall, a four-story building with 30,000 square feet of laboratory and office space. MRC has an active interest in industrial research and economic development which is suitable for graduate student education and which falls within the technical expertise of the staff. The center contains all the modern equipment needed for research on

common mechanical, thermal, electrical, and optical properties. It contains specialized and adaptable experimental facilities for:

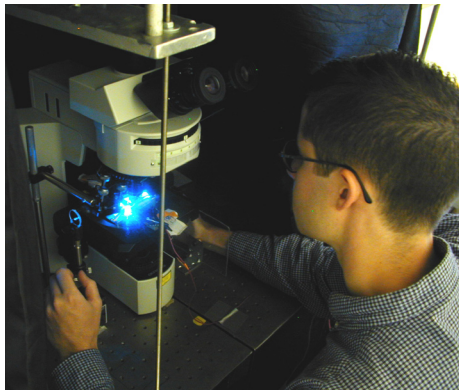
- Ceramic superlattice electrode position
- Electrochemical characterization for deposition and corrosion
- Electronic materials
- Ferroelectric ceramics
- Glass melting (up to 1650oC), fiber drawing, flame spheroidization and property measurements
- Nanomaterials
- Plasma deposition of materials
- Biomaterials
- Compositions
- Structural characterization by x-ray diffraction, electron microcopy (including field-emission SEM) scanning tunneling microcopy and atomic force microscopy.

Surface analysis is also available via x-ray photoelectron and Auger electron spectroscopy.

## *Missouri University of Science and Technology Coatings Institute*

(Michael R. Van De Mark, Director)

The Missouri S&T Coatings Institute occupies a 10,000 square foot building about one block from Schrenk Hall. The Institute has been serving the coatings industry for over 40 years and has an excellent working relationship with it. Our graduates are chemistry majors



with their research being in polymers and coatings. Several of the faculty interact with the Institute including Dr. James Stoffer and Dr. Harvest Collier. The Institute acts as a central point of equipment sharing. The facility has a full complement of coatings related equipment including:

- Instron
- AC Impedance
- Minimum Film Forming Temperature
- Abrasion
- Brookfield Viscometers
- Q-Fog Cyclic Salt Fog
- Q-UV Weatherometer
- Differential Laser Refractometer
- Densitometer
- Dispersion Mills Including Cowles, Myers, Zinger, CB Mill and Kady

Our students have found ready acceptance into the industry in the ink, paint, resin, pigment, and additive manufacturers. In addition many end users also hire our graduates. Most of the students who are involved with the institute attend the ICE show annually at a major city. This show features over 350 exhibits and exposes our students to this highly technical industry.

### Facilities

The department support facilities includes a glass blower and a glass shop, an electrical engineer and electronics shop, an instrument specialist, and a NMR specialist. These facilities can be used by students and faculty for research. Staff members assist students and faculty with their projects and maintain equipment used for scientific research.

## *Center for Environmental Science and Technology*

The Center for Environmental Science and Technology (CEST) is an expression of commitment by the university to be a positive force in helping society deal with environmental problems and concerns. Its mission is to involve students in the resolution of real-world environmental problems by enlisting them in research programs at Missouri S&T. To this end CEST fosters academic (students and faculty), industrial, and government laboratory participation in interdisciplinary environmental research. This multi-faceted program brings to bear new and existing technologies to the solution of environmental problems.

CEST may, therefore, be considered a catalyst for environmental research and teaching. It brings together under a common umbrella more than 25 faculty as senior investigators (including Drs. S. Kapila and P. D. Whitefield from Chemistry), research investigator (N. Ercal), and adjunct investigators. Represented are more than a dozen engineering, physical science, life science, mining, and metallurgical disciplines. CEST also brings together a wide array of extraordinary laboratories and institutes. These have an impressive array of capabilities and unique expertise in cloud and aerosol sciences, materials research and recycling, environmental trace, coatings technology, environmental monitoring, and many other areas.



## Partial List of Companies who have Employed Chemistry Alumni

3M	Dow	Monsanto
Abbott	Dupont	Novartis
Air Products	Eli Lilly	NASA
Allied Signal	Ethyl	NOVUS
Amoco	Exxon	Pfizer
Anheuser-Busch	General Electric	Phillips
ARCO	General Motors	PPG
Ashland	Goodyear	Procter & Gamble
BASF	Hewlett Packard	Rhone-Poulenc
Bayer	Hoechst-Celanese	Rohm & Haas
Benjamin Moore	IBM	Shell
Boeing	International Paper	Sherwin Williams
Bristol Meyers-Squibb	Johnson and Johnson	Sigma
Cabot	Kimberly Clark	Texaco
Chevron	Lockheed	Union Carbide
CIBA	Mallinckrodt	United Technology
Conoco	Marion Hoechst Roussel	Warner-Lambert
Corning	Merck	Westinghouse



### ***Assistantship and Fellowship opportunities:***

The salaries for teaching assistants and research assistants are competitive, and due to the generosity of industrial sponsors, can be supplemented with research fellowships for students with GPA > 3.20 and further supplements for students with GPA > 3.50.

Incoming Ph.D. candidates with a GPA of 3.5 are also eligible for Chancellor's Fellowships. These pay all tuition for the entire Ph.D. program. To be eligible for a Chancellor's Fellowship for the fall semester, we need to have your completed application and all necessary documents by March 15 of the year when the scholarship is to begin. Earlier receipt of these documents will be helpful.

#### Award Guidelines

1. Chancellor's Fellowships are to be awarded to students to encourage them to begin and complete a Ph.D. course of study at Missouri S&T. Non-thesis masters' students are not eligible.
2. Chancellor's Fellowships will normally be awarded during the Spring Semester and may be used beginning with the Summer Session, the Fall Semester, or the following Spring Semester.
3. The basis for awarding Chancellor's Fellowships will be the undergraduate or graduate grade point average (normally  $\geq 3.50$ ), Graduate Record Examination (GRE) scores or Graduate Management Admissions Test (GMAT), rank in graduating class, etc.
4. Recipients are limited to American citizens and permanent residents.
5. Support continues, subject to the time restrictions above, for a Chancellor's Fellow as long as it is toward the student's approved PhD program (Form 5A) or approved MS program (Form I). (Maximum 36 credit hours for MS and 60 credit hours for PhD beyond MS.)
6. Chancellor's Fellowships are not to be used for students who are not enrolled as regular graduate students on the Missouri S&T campus, or for continuous registration, or for examination only.
7. Chancellor's Fellows will be assessed any late registration fees.
8. Chancellor's Fellows dropped for failure to maintain satisfactory progress are not eligible for reappointment as Chancellor's Fellows.
9. Students holding a fellowship that pays fees or a cost-of-education allowance are not eligible for Chancellor's Fellowships.
10. Chancellor's Fellows not on academic appointment must carry nine hours in each fall/winter semester.

# DEGREE PROGRAMS

The Chemistry Department offers graduate programs leading to the Doctor of Philosophy, Master of Science with Thesis, and Master of Science without Thesis degrees. These graduate degree programs are designed to provide the students with the opportunity to develop an expertise in a specialized field, and to broaden their general working knowledge of all disciplines of chemistry.

All students upon entering the program are required to take placement examinations. These examinations are for the benefit of the student for three reasons. First, they offer the exceptional student the opportunity to place out of entry-level graduate courses, thereby allowing more time for advanced studies and research. Second, students can use the results from these examinations to determine which areas of chemistry, they need to study further. Third, the student and his/her advisor can more effectively design a program of study that best meets the needs of the student.

Graduate degrees in chemistry at Missouri S&T are awarded to students who demonstrate scholarly achievement beyond the ordinary. All graduates must pass the teaching workshop with a grade of B or better before taking the comprehensive or final defense in pursuit of an advanced degree.

The following is a brief synopsis of the requirements for the three degrees. More detailed information is available in the Missouri S&T Graduate Bulletin. It should be mentioned that the Chemistry Department does not have a foreign language requirement.

## *Doctor of Philosophy*

This degree is awarded for original research in chemistry. Students electing this program must fulfill the following requirements.

- Complete a minimum of 24 credit hours of graduate level coursework. Students are encouraged to concentrate on completing this coursework requirement in the first several semesters of their program of study. Typically, students elect to take between 9 and 12 graduate credits per semester.

- Select a research advisor and four additional members for a graduate advisory committee. This committee is made up of four faculty from the Chemistry Department and one from another department. This should be done by the sixth week of the second semester of the student's entrance year.

- Students must complete requirements for the report of qualifying exam. This requirement is satisfied when the student takes the placement exams and subsequently completes all requirements stipulated as a result of placement exams. These placement requirements should be completed by the end of the second year.

- Conduct an original research program with his/her selected advisor. This research program can begin as early as the second semester of the student's entry year, and will continue until the writing and submission of the Ph.D. thesis. A minimum of 24 research credit hours is required, which are easily obtained during the student's latter years in the program.

- In the third year, pass a comprehensive examination. This requirement may be satisfied, with the permission of the advisory committee, by the writing and oral defense of an original research proposal. This requirement is valued by the faculty as a necessary experience for the students, because the formulation of original ideas and the writing of successful proposals is such a critical skill needed by most Ph.D. level professional chemists. This requirement is usually fulfilled by the end of the third year.

- Write a satisfactory Ph.D. thesis, and pass an oral examination on its content and related topics.

## *Master of Science (with Thesis)*

The requirements for this degree are similar to those for the Ph.D., except that the required level of research effort is reduced.

- Complete a minimum of 30 credit hours of graduate level coursework, including no more than 12 hours of research, special problems or graduate seminar.



- Select a research advisor and two additional members for a graduate advisory committee. This committee is made up of two faculty from the Chemistry Department and one from another department. This should be done by the sixth week of the second semester of the student's entrance year.

- Conduct an original research program with his/her selected advisor. This research program can begin as early as the second semester of the student's entry year, and will continue until the writing and submission of the M.S. thesis.

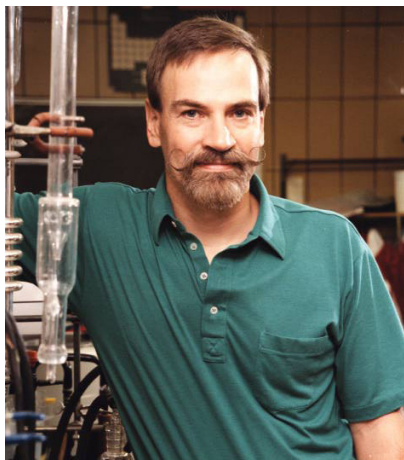
- Write a satisfactory M.S. thesis, and pass an oral examination on its content and related topics.

## *Master of Science (Without Thesis)*

This is a non-research degree for students wishing to expand their working knowledge of chemistry beyond that afforded at the Bachelor of Science level. This program allows the student to build a firm working foundation of the major chemical disciplines, and provides an opportunity for extensive exploration of many areas of specialization. The student's advisor and graduate advisory committee will be appointed by the Chairman of the Department. Students electing this program are required to fulfill the following requirements.

- Complete a minimum of 33 credit hours of graduate level coursework. Typically, students elect to take between 9 and 15 graduate credits per semester.

- Pass a comprehensive examination administered by the Chemistry Department.



## Frank D. Blum

fblum@mst.edu

Curators' Professor and Senior Investigator - Materials Research Center, and Adjunct Professor, Material Science and Engineering, University of Lund, Sweden, Visiting Professor, 1997; IBM Almaden Research Center, Visiting Scientist, 1992; Eastern Illinois University, B.S., 1976, M.S., 1977; University of Minnesota, Ph.D., 1981.

Research Interests: Polymers, Colloids, Physical Chemistry, Materials, and Nanomaterials.

Our research group focuses on i) polymer-surface interactions, ii) polymer-solvent interactions, iii) composites, and iv) nanomaterials. Many of our studies use nuclear magnetic resonance (NMR) spectroscopy and mechanical studies to link the microscopic and macroscopic properties of the systems.

We are especially interested in the role that interfacial chemistry plays in the development of new materials. Frequently, the interfaces between dissimilar species provide opportunities for improvements in materials designed for specific applications such as advanced composites and electronic materials. As these systems get smaller, the interfaces between the dissimilar materials in them become even more important. We also make and test materials with interesting interfacial properties in order to understand how they work. This includes new polymer systems, especially polymer thin films. Our understanding of these systems is based on their characterization with deuterium NMR, FT-IR, modulated differential scanning calorimetry, atomic force microscopy, and other techniques. We have found that interfaces generally are heterogeneous with respect to their dynamics. This heterogeneity affects the mechanical properties of the systems that they are used in, including adhesion, strength, and modulus.

For more information see: <http://www.mst.edu/~fblum>

### Selected Publications:

M.O. Okuom, B. Metin, F.D. Blum, Segmental Dynamics of Poly(Methyl Acrylate)-d<sub>3</sub> Adsorbed on Anopore - A Deuterium NMR Study, *Langmuir*, **24**, 2539-2544 (2008). DOI: 10.1021/la703103j

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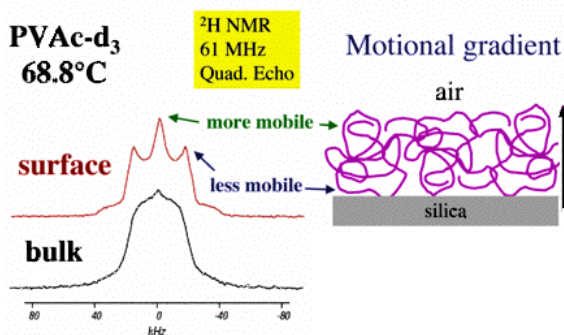
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## FACULTY

### Bulk - Surface Comparison



Deuterium NMR spectra (left) of bulk and surface adsorbed (on silica) poly(methyl acrylate)-d<sub>3</sub>. The surface spectra shows components due to polymer segments which are more mobile and some that are less mobile than those in the bulk sample. The drawing shows a hypothetical adsorbed-polymer layer with the corresponding more and less mobile regions.

## Selected Publications:

Ongwandee, M.; Morrison, G. C.; Guo, X.; Chusuei, C. C. "Adsorption of Trimethylamine on Zirconium Silicate and Polyethylene Powder Surfaces." *Colloids Surf. A.* (2007), in press.

Augustine, B. H.; Hughes, W. C.; Zimmerman, A. J.; Guo, X.; Chusuei, C. C.; Maidment, J. S. "Plasma Surface Modification and Characterization of POSS-based Nonocomposite Polymeric Thin Films." *Langmuir*, **23**, 4346-4350 (2007).

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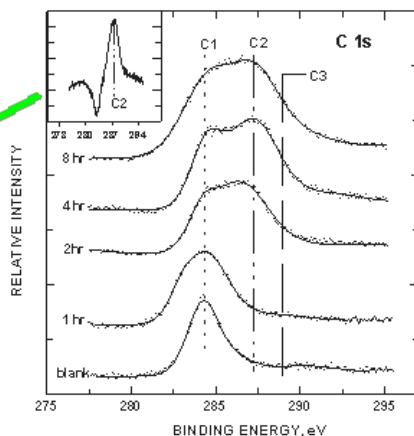
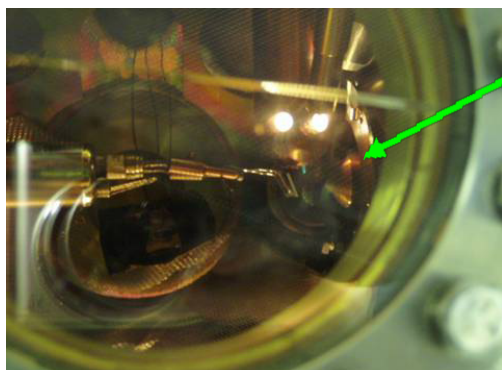
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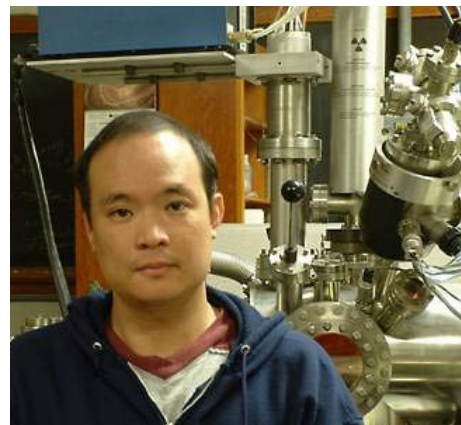
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Stackplot of XPS C 1s spectra obtained in our lab of -COOH, -COH and -C=O functionalized multiwalled carbon nanotubes [Langmuir 21 (2005) 4185].



## Charles C. Chusuei

chusuei@mst.edu

Assistant Professor and Research Investigator of Materials Research Center George Mason University, Ph.D. (1997); Assoc. Western Universities Postdoctoral Fellow, Pacific Northwest National Lab. and Texas A&M University (1997-2000); Senior Research Scientist, Colorado State University (2001)

Research Interests: Analytical/physical chemistry, surface science.

Chemical Analysis at the Solid-Aqueous Solution Interface:

The theme of our research is the understanding molecular-scale processes that govern the binding and release of metal oxyanions and cations in aqueous solution environments on well-defined and powder metal oxide surfaces. Elucidations of fundamental processes involved therein are important for a variety of applications, including antifouling of naval vessels, biomaterial implants and environmental remediation. We have also extended our methods for probing functionalized carbon nanotubes for applications in fuel cell technology. In our approach, simple model systems are studied to gain mechanistic insight into more complex macroscopic systems. Surface analytical methods (predominately XPS) are employed for these investigations coupled with bulk solution methods (AA, ICP) to get a complete picture of the solid-aqueous solution interface.

For more information see: <http://www.mst.edu/~chusuei>



## Harvest L. Collier

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Vice Provost for Undergraduate Studies,  
Professor and Research Investigator of Materials Research Center  
Mississippi State University, B.S., 1972,  
M.S., 1974, Ph.D., 1977. Dow Chemical  
Company, 1977-1982.

Research Interests: Inorganic/Organo-metallic/Polymer Chemistry/Coating Science.

Synthesis and characterization of metallo-macrocycles, kinetics and mechanism of macrocycle reactivity; preparation and characterization of metal ion binding polymers; thermal, electroconductive and electrochemical characterization of macromolecular complexes; application and evaluation of polymers and inorganics as protective coatings.

### Selected Publications:

Feng He, Klarash Alavi Shooshtari, and Harvest Collier, "Synthesis and characterization of series monomers and polymers of 2,2'-biimidazole," *Polymer Preprints (American Chemical Society, Division of Polymer Chemistry)* **42(2)**, 379-380. (2001).

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Paula M Secondo, John M Land, Russel G Baughman and Harvest Collier, "Polymeric Octahedral and Monomeric Tetrahedral Group 12 Pseudohalogeno (NCX<sub>2</sub>; X = O, S, Se) Complexes of 4-(N,N-Dimethylamino)pyridine," *Inorg. Chem. Acta*, **309**, 13-22 (2000).

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Geng Lin, Harvest Collier and Russel G Baughman, "1-Hydroxyethyl-2,2'-biimidazole Acta Crystallogr.," *Sect. C: Cryst. Struct. Commun.*, **55**, 476-478 (1999).

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H. L. Collier, G. L. Bertrand, and R. L. Venable, "Improved Paint Stripper Composition Having Reduced Volatility Containing Decanolacetone, N-Methyl-pyrrolidone and Butyrolactone and Method of Use," #5,073,289 (Dec. 12, 1991).

H. L. Collier and S. S. Kandil, "Hexaaza Macrocyclic Complexes Containing Biimidazole, Part 1. Synthesis and Characterization of Ni(II), Cu(II) and Pd(II) Complexes of 2,7-dialkyl-1,3,6,8,11,14-hexaazacyclohexadeca-1,7-diene," *Inorg. Chem.*, **27**, 4542 (1988).

## Selected Publications:

A. Banerjee, M. Trueblood, X. Zhang, K.R. Manda, P. Lobo, P.D. Whitefield, D.E. Hagen, N. Ercal, "N-Acetylcysteine Amide (NACA) Prevents Inflammation and Oxidative Stress in Animals Exposed to Diesel Exhaust Particles. *Toxicol Letters*. 187: 187-193, (2009).

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R. Shi, C.C. Huang, R.S. Aronstam, N. Ercal, A. Martin, Y.W. Huang, "N-Acetylcysteine Amide Decreases Oxidative Stress But Not Cell Death Induced by Doxorubicin in H9c2 Cardiomyocytes" *Biomedical Chromatography Pharmacol*, 15:9(1):7, (2009).

B. Ates, B.C. Ercal, K. Manda, L.S. Abraham, N. Ercal, "Determination of Glutathione Disulfide Levels in Biological Samples Using Thiol-disulfide Exchanging Agent, Dithiothreitol (DTT)" *Biomedical Chromatography*, 23(2):119-123, (2009).

O. Demirkol, A. Cagri-Mehmetoglu, Z. Qiang, N. Ercal, and C. Adams, "Impact of Food Disinfection on Beneficial Biothiols Contents in Strawberry" *J. of Agriculture and Food Chemistry*, 56(21):10414-10421, (2008).

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J. Ogony, R.H. Matthews, H. Anni, K. Shannon, N. Ercal, "The mechanism of elevated toxicity in HepG2 cells due to combined exposure to ethanol and ionizing radiation" *J Appl Toxicol*, 28:345-355, (2008).

V.R. Kalapatapu, L. Satterfield, A.T. Brown, H. Chen, N. Ercal, T.O. Price, J. Gao, K. Ibrahim and M.M. Moursi, "The effects of toradol on postoperative intimal hyperplasia in a rat carotid endarterectomy model: laboratory research" *Vasc Endovascular Surg*, 41:402-408, (2007).

S. Mare, S. Penugonda, SM. Robinson, S. Dohgu, WA Banks, and N. Ercal, "Copper complexing decreases the ability of amyloid beta peptide to cross the BBB and enter the brain parenchyma," *Peptides*, 28: 1424-1432 (2007).

W. A. Banks, N. Ercal, and T. Otamis-Price, "The Blood-brain Barrier in NeuroAIDS" *Curr HIV Res*, 4 (3): 259-266, (2006).



## Nuran Ercal

nercal@mst.edu

Vitek Endowed Chair in Biochemistry  
Istanbul Medical Faculty, M.D., 1981; Ohio State University, M.S., 1988; Hacettepe University, Ph.D., 1990.

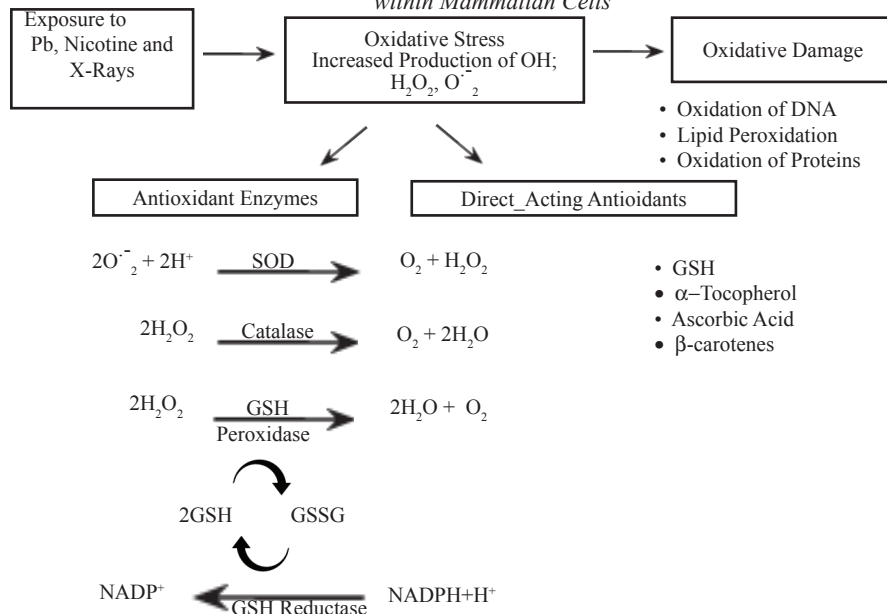
Research Interests: Analytical Biochemistry, Metal Toxicity, Free Radicals in Biological Systems.

Our research interests lie in the area of oxidative stress-related disorders, particularly in understanding the role of oxidative stress in maintaining the permeability of the blood brain barrier (BBB). One area under investigation is the exploration of new chelators for lead poisoning since current chelators have severe side effects. The main purpose of chelation therapies should be to remove lead from the system with minimal detrimental side effects, but removal of lead by chelators seems to harm the most crucial tissues by redistributing lead from its storage bone site. Our studies demonstrated that treatment of lead poisoning with N-acetylcysteine (NAC) seemed to diminish "oxidative stress" and it also showed some chelating action in lead-exposed animals. We are also exploring the use of natural antioxidants including  $\alpha$ -lipoic acid, taurine,  $\alpha$ -tocopherol and ascorbic acid in the treatment of lead poisoning.

Eventually, we hope to provide evidence supporting the use of antioxidants as a safe and effective treatment for a segment of the human population (children with moderate blood-lead levels) presently left untreated.

We are applying the same treatment to other free radical-related conditions such as radiation, nicotine-induced complications, and copper toxicity.

### Effects of Lead, Nicotine and X-Rays on Prooxidant/Antioxidant Balance within Mammalian Cells





## Shubhender Kapila

kapilas@mst.edu

MSMC Endowed Professor

Punjab A. University, B.S., 1972; University of Missouri, M.S., 1974; Dalhousie University, Ph.D., 1977.

Research Interests: Environmental chemistry and mass spectrometry.

### Analytical Chemistry

- Solvating properties of supercritical fluids, development of supercritical fluid extraction (SFE) based on-line analysis systems;
- Development of selective detectors / sensors
- Sorption kinetics and development of surface modified adsorbents
- Multidimensional chromatography systems and applications for confirmatory analysis.
- Tandem mass spectrometry- Peptide characterization

### Environmental Sciences and Biomaterials

- Environmental transport and transformation of xenobiotics.
- Development and evaluation of integrated remediation techniques for decontamination.
- Development of wide spectrum microbial disinfectants
- Development of resource recovery techniques
- Development of biogenic oil based solvents, coatings, resins, polymers and composites.
- Synthesis of tailored peptides
- Enzymatic methods for enantio-enrichment of amino and hydroxy acids.

### Selected Publications:

R.Yadav, A. Shabeer, S. Sundararaman, K. Chandrashekhara, V. Flanigan and S. Kapila, "Development and characterization of soy-based epoxy foams." Accepted for publication in Proceedings of SAMPE Conference, (2006).

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M. Kafeel Ahamed, R. Seemamahannop, S. Kapila, V. Flanigan and K. Chandrashekhara, "Rice hull nano silica as fire retardant in epoxy composites." Accepted for publication in Proceedings of SAMPE Conference, (2006).

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R.Seemamahannop, S. Kapila, V.Flanigan, K.Chandrashekhara, N.Sreenivasan and Vander Tumiatt, "Generation Of High Surface Silica From Rice Hulls And Its Incorporation In Biogenic Oil Derived Epoxy Composites" Proceedings of the V International Conference on Value Added Resource Recovery, (2005), L'Aquila, Italy

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## Selected Publications:

“One-Pot Synthesis of Interpenetrating Inorganic/Organic Networks of CuO/Resorcinol-Formaldehyde Aerogels: Nanostructured Energetic Materials,” N. Leventis, N. Chandrasekaran, A. G. Sadekar, C. Sotiriou-Leventis and H. Lu *J. Am. Chem. Soc.* 2009, 131(13), 4576-4577.

“Smelting in the Age of Nano: Iron Aerogels,” N. Leventis, N. Chandrasekaran, C. Sotiriou-Leventis and A. Mumtaz *J. Mater. Chem.* 2009, 19, 63-65

“Macroporous Electrically Conducting Carbon Networks by Pyrolysis of Isocyanate Cross-Linked Resorcinol-Formaldehyde Aerogels,” N. Leventis, S. Mulik, C. Sotiriou-Leventis *Chem. Mater.* 2008, 20, 6985-6997

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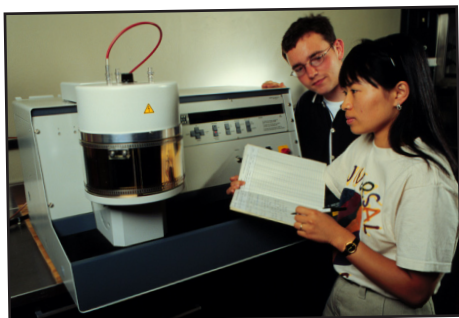
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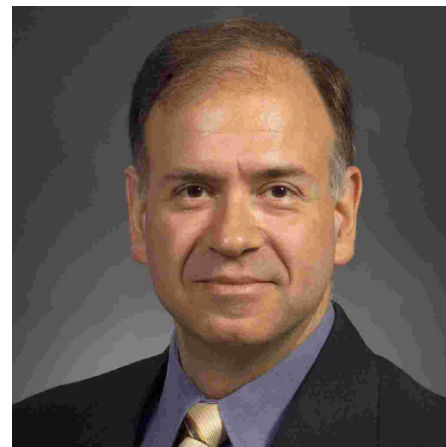
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Ian Elder and Xuerong Gao operating an evaporator/sputterer in Dr. Leventis' laboratory.



## Nicholas Leventis

leventis@mst.edu

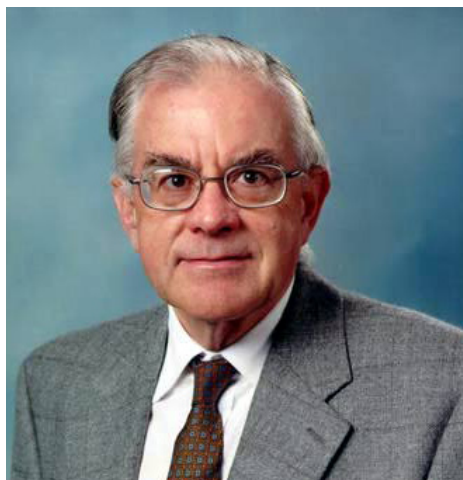
Curators' Professor

University of Athens-Greece, B.S., 1980; Michigan State University, Ph.D., 1985; Massachusetts Institute of Technology, Post-doctoral Fellow, 1985-88; Harvard University, CSS-Management, 1992; Director of Research, Molecular Displays, Inc., 1988-93. Assistant Professor, University of Missouri-Rolla, 1994-1999, Associate Professor, 1999-2007, Professor 2007, Senior Chemical Engineer, NASA Glenn Research Center 2002-2006.

Research Interests: Physical, Analytical and Organic Electrochemistry. Sol-Gel Materials. Polymer Crosslinked Aerogels. Nanotechnology.

My research group provides a multi-disciplinary environment for training of graduate students emphasizing the opportunities that exist in the interface of traditional fields. Areas of interest are: (a) Polymer crosslinked aerogels: templated nanocasting of a polymer on the fragile skeletal framework of silica aerogels increases the density by a factor of “3” and the strength by a factor of “300.” (Technology Nano50 Award 2005, NASA Exceptional Scientific Achievement Medal 2005, Innovator Nano50 Award 2007.); (b) Study of magnetic effects on electrochemical systems: magnetohydrodynamic convection, paramagnetic forces and magnetic effects on corrosion; (c) Study of the effect of multiple substitution on the redox chemistry of organic systems; (d) Supramolecular chemistry: host-guest complexes of cucurbit [7] uril; (e) Synthesis and doping of sol-gel materials with ruthenium complex-electron acceptor dyads for application in chemical sensors and optical switches.





## Gary J. Long

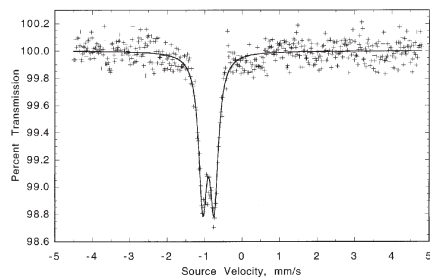
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Professor

Carnegie Mellon University, B.S., 1964;  
Syracuse University, Ph.D., 1968.

Inorganic and Solid State Chemistry.

The synthesis and study of the electronic and structural properties of transition metal complexes and solid state materials by using infrared, electronic and Mössbauer spectroscopy, x-ray and neutron diffraction methods, and low temperature magnetic susceptibility techniques; the study of the electron density distributions in transition metal complexes and organometallic clusters; the study of hard permanent magnetic materials and thermoelectric materials.



The Mössbauer spectrum of  $\text{KZr}_6\text{FeCl}_{15}$  obtained at 78 K.

### Selected Publications:

F. Grandjean, M. T. Sougrati, H. Mayot, O. Isnard, and G. J. Long, "A Study of the Unusual High Temperature Spin Reorientation in  $\text{YCoFe}_3\text{B}$ ," *J. Phys.: Condens. Matter*, **21**, 186001 (7 pages) (2009).

C. Ni, J. C. Fettinger, G. J. Long, and P. P. Power, "Spin-State Crossover and Structural Changes in a Cobalt(II) Organometallic Species: Low-Coordinate, First Row, Heteroleptic Amido Transition Metal Aryls. Synthesis and Characterization of  $\text{Ar}^n\text{MN}(\text{H})\text{Ar}^m$  ( $\text{M} = \text{Mn, Fe, Co}$ ) ( $\text{Ar}^n = \text{C}_6\text{H}_3\text{-2,6-(C}_6\text{H}_3\text{-2,6-}^i\text{Pr}_2)_2$ ,  $\text{Ar}^m = \text{C}_6\text{H}_3\text{-2,6-(C}_6\text{H}_2\text{-2,4,6-Me}_3)_2$ )," *Inorg. Chem.*, **48**, 2443-2448 (2009).

F. Luo, J.-M. Zheng, and G. J. Long, "Unique Atomic Eight-Connected Net with  $3^6 4^{18} 5^3 6$  Topology Derived from a Rare  $\text{Co}_6(\mu_3\text{-OH})_2(\mu\text{-H}_2\text{O})(\text{CO}_2)_{12}$  Building Block," *Cryst. Growth Des.*, **9**, 1271-1274 (2009).

M. A. McGuire, R. P. Hermann, A. S. Sefat, B. C. Sales, R. Jin, D. Mandrus, F. Grandjean, and G. J. Long, "Influence of the Rare-earth Element on the Effects of the Structural and Magnetic Phase Transitions in  $\text{CeFeAsO}$ ,  $\text{PrFeAsO}$ , and  $\text{NdFeAsO}$ ," *New J. Phys.*, **11**, 025011 (16 pages) (2009).

Y.-Z. Zheng, W. Xue, W.-X. Zhang, M.-L. Tong, X.-M. Chen, F. Grandjean, G. J. Long, S.-W. Ng, P. Panissod, and M. Drillon, "Spin-Frustrated Complex,  $[\text{Fe}^{\text{II}}\text{Fe}^{\text{III}}(\text{trans-1,4-cyclohexane-dicarboxylate})_{1.5}]_x$ : Interplay between Single-Chain Magnet Behavior and Magnetic Ordering," *Inorg. Chem.*, **48**, 2028-2042 (2009).

C. Ni, J. C. Fettinger, G. J. Long, M. Brynda, and P. P. Power, "Reaction of a Sterically Encumbered Iron(I) Aryl/Arene with Organoazides: Formation of an Iron(V) Bis(imide)," *J. Chem. Soc., Chem. Commun.*, 6045-6047 (2008).

S. E. Dutton, P. D. Battle, F. Grandjean, G. J. Long, and K. Oh-ishi, "Structural Chemistry and Magnetic Properties of  $\text{Nd}_{18}\text{Li}_8\text{Fe}_5\text{O}_{39}$  and  $\text{Nd}_{18}\text{Li}_8\text{Co}_4\text{O}_{39}$ : The Interplay of Atomic, Charge, and Spin Ordering," *Inorg. Chem.*, **47**, 11212-11222 (2008).

T. Nguyen, W. A. Merrill, C. Ni, H. Lei, J. C. Fettinger, B. D. Ellis, G. J. Long, M. Brynda, and P. P. Power, "Synthesis and Characterization of the Metal(I) Dimers  $[\text{Ar}^n\text{MMAr}^m]$ : Comparisons with Quintuple-Bonded  $[\text{Ar}^n\text{CrCrAr}^m]$ ," *Angew. Chem. Int. Ed.*, **47**, 9115-9117 (2008).

H. Lei, B. D. Ellis, C. Ni, F. Grandjean, G. J. Long, and P. P. Power, "An Arene-Stabilized Cobalt(I) Aryl: Reactions with CO and NO," *Inorg. Chem.*, **47**, 10205-10207 (2008).

M. T. Sougrati, R. P. Hermann, F. Grandjean, G. J. Long, and K. H. J. Buschow, "A Structural, Magnetic, and Mössbauer Spectral Study of the Magnetocaloric  $\text{Mn}_{1-x}\text{Fe}_{0.9}\text{P}_{1-x}\text{Ge}_x$  Compounds," *J. Phys.: Condens. Matter*, **20**, 475206-1-9 (2008).

F. Luo, G. J. Long, Y.-X. Che, and J.-M. Zheng, " $\text{Ln}_2(\text{C}_2\text{O}_4)(\text{O}_2\text{CCH}_2\text{OH})_4$  ( $\text{Ln} = \text{Gd(III), Tb(III)}$ ): Unprecedented Interpenetrating 4,6-Connected Net Built on Unusual Rectangular and Distorted Hexagonal Lanthanide Nodes," *Cryst. Growth Des.*, **8**, 3511-3513 (2008).

M. A. McGuire, A. D. Christianson, A. S. Sefat, B. C. Sales, M. D. Lumsden, R. Jin, E. A. Payzant, D. Mandrus, Y. Luan, V. Keppens, V. Varadarajan, J. W. Brill, R. P. Hermann, M. T. Sougrati, F. Grandjean, and G. J. Long, "Phase transitions in  $\text{LaFeAsO}$ : structural, magnetic, elastic, and transport properties, heat capacity and Mössbauer spectra," *Phys. Rev. B*, **78**, 094517-1-10 (2008).

T. Owen, F. Grandjean, G. J. Long, K. V. Domasevitch, and N. Gerasimchuk, "Synthesis and Characterization of Two Intensely Colored *Tris*(benzoylcyanoxime)iron(II) Anionic Complexes," *Inorg. Chem.*, **47**, 8704-8713 (2008).

## Selected Publications:

Heng Liang, Xiaoliang Cheng, and Yinfa Ma, "Localized Single Molecule Isotherms of DNA Molecules at Confined Liquid/Solid Interface", *Analytical Chemistry*, 2009, 81, 2059-2066.

Weisheng Lin, Yinfa Ma, Katie B. Shannon, Yue-wern Huang, "Toxicity of nano- and macro-sized ZnO particles in human lung epithelial cells". *Journal of Nanoparticle Research*, 2009, 11, 25-39.

Xue Han Ming Du Yinfa Ma Delbert E. Day, "Evaluation of hydroxyapatite microspheres made from a borate glass to separate protein mixtures", *Journal of Materials Science*, 2008, 43, 5618-5625.

Weisheng Lin, Isaac Stayton, Yue-wern Huang, Xiao-Dong Zhou, and Yinfa Ma, "Cytotoxicity and Cell Membrane Depolarization Induced by Aluminum Oxide Nanoparticles in Human Lung Epithelial Cells A549", *Toxicological and Environmental Chemistry*, 2008, 90, 983-996.

Mary Adams, Weisheng Lin, Yinfa Ma, "Quantitative Determination of ZnO Nanoparticles in Human Bronchoalveolar Carcinoma-Derived Lung Cancer Cells", *Journal of Undergraduate Chemical Research*, 2007, 6, 19-22.

Ming Du, James H. Flanagan, Jr.(1) and Yinfa Ma\*, "Separation of Homo- and Heteroduplexes of DNA Fragments with Different Melting Temperature by Capillary Electrophoresis at One Single Temperature", *Journal of Capillary Electrophoresis and Microchip Technology*, 2007, 10, 33-39.

Weisheng Lin, Haiying Shi, Trisha May, Honglan Shi, and Yinfa Ma, "Determination of Benzyltriethyl Ammonium Chloride from Polymeric Media by Capillary Electrophoresis with Ultraviolet Absorbance Detection", *Analytica Chimica Acta*, 2007, 583, 98-102.

Weisheng Lin, Yue-wern Huang, Xiao-Dong Zhou, and Yinfa Ma, "Toxicity of Cerium Oxide Nanoparticles in Human Lung Cancer Cells", *International Journal of Toxicology*, 2006, 25, 451-457.

Tongwen Wang, Paul Ki-souk Nam\*, Honglan Shi, and Yinfa Ma, "Compositional Monosaccharide Analysis of Transgenic Corn Glycoproteins by HPLC with Fluorescence Detection and LC/MS with Sonic Spray Ionization", *Journal of Chromatographic Science*, 2007, 45, 200-206.

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Hongwei Gai, Qi Wang, Yinfa Ma, Bingcheng Lin, "Correlations between molecular numbers and molecular masses in an evanescent field and their applications in probing molecular interactions", *Angewandte Chemie*, 2005, 44, 5107-5110.

Zahra Afrasiabi, Ekk Sinn, Weisheng Lin, Yinfa Ma, Charles Campana, Subhash Padhye, Nickel (II) complexes of naphthaquinone thiosemicarbazone and semicarbazone: Synthesis, structure, spectroscopy, and biological activity, *Journal of Inorganic Biochemistry*, 2005, 99, 1526-1531.

Hongwei Gai, Ying Li, Zhanhua Silber-Li, Yinfa Ma, Bingcheng Lin, "Simultaneously measurements the velocities of particle/single molecules in bulk flow and near wall flow in microchannel", *Lab on Chip*, 2005, 5, 443-449.

Guanyu Yang, Yinfa Ma, and Jie Xu, "A Biomimetic Catalytic System Driven by Electron Transfer for Selective Oxygenation of Hydrocarbon", *J. Am. Chem. Soc.*, 2004, 126, 10542-10543.

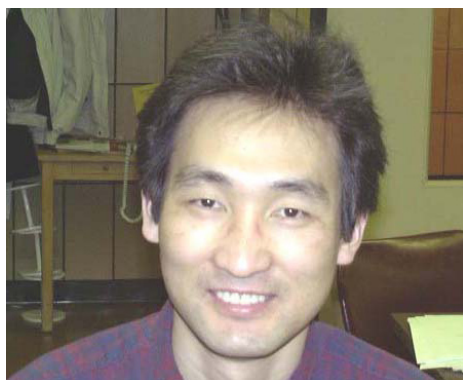


## Yinfa Ma

yinfa@mst.edu

Curators' Teaching Professor  
Zhengzhou University, China, B.S.,  
1981, Iowa State University, Ph.D.,  
1990. Analytical Chemistry, Iowa  
State University, Research Scientist,  
1999-2000

**Research Interests:** This research group focuses on environmental analysis, bio-analysis and bio-separations, including environmental contaminants, toxins, DNAs, proteins, peptides, amino acids, small molecules, cancer markers and other biological compounds. Research is conducted using high performance liquid chromatography (HPLC), high performance thin layer chromatography (HPTLC), high performance capillary electrophoresis (HPCE), GC-MS, HPLC-MS, HPCE-MS, gel electrophoresis, and size-exclusion chromatography, in an attempt to develop new bioanalytical instrumentation and procedures. Laser spectroscopy, standard "wet" chemistry plus the extensive use of personal computers for data collection and data processing are also incorporated into all of the research projects. In addition, we have focused on precancer screening for the past several years and will continue with this research project in the years to come. Precancer screening at the single molecular level is our eventual goal.



## Paul Nam

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Assistant Professor Research Investigator  
of Center for Environmental Science &  
Technology

University of Hawaii, B.S., 1985; Univer-  
sity of Missouri-Columbia, M.S.,  
1988; University of Missouri-Columbia,  
Ph.D., 1991; U.S. Department of  
Agriculture - ARS, Postdoctoral Fellow,  
1992-1995

Research Interests: Analytical Chemistry  
and Environmental Chemistry.

Analysis of trace-level endocrine disruptors (hormone-like chemicals) in aquatic environment using analytical techniques based on GC/MS and LC/MS to assess the effect of anthropogenic activities; MS-based characterization of bio-molecules such as amino acids, peptides, proteins, etc.; In-situ real-time chemical and physical characterization and monitoring of airborne aerosols from emission sources including oil vapor, combustion, engine exhaust, and nanoparticle productions; Study of fate and migration of organic and inorganic pollutants in air, water, and soil; Chemical vapor detection devices for explosives and chemical warfare agents; Development of soy-based products and analyses for major and minor composition; Interdisciplinary approach to economical and safe remediation techniques; Fundamental study and applications of supercritical fluid extraction and chromatography.

## Selected Publications:

Mathur Rajesh, Shubhen Kapila, Paul Nam, Daniel Forciniti, Stephen Lorbert, and Charles Schasteen, "Enzymatic Synthesis and Characterization of L-Methionine and 2-Hydroxy-4-(methylthio) butanoic Acid (HMB) Co-oligomers, *J. Agric. Food Chem.*, **51**, 2461-2467, (2003).

V. Flanigan, H. Shi, N. Nateri, P. Nam, K. Lee, S. Kapila, "A fluidized bed combustor for treatment of high moisture content waste", *Proceedings of the IV International Conference on Value Added Resource Recovery*, L'Aquila, Italy, (2003).

Yvonne Liske, Shubhen Kapila, Virgil Flanigan, Paul Nam and Steve Lorbert, "Production of Feedstock Chemicals from Ammonium Sulfate and Ammonium Bisulfate," *J. Hazardous Subs Research*, (ISSN 1090-7025), **2**, 8-11 (2001).

P. Nam, S. Kapila, Q. H. Liu, and W. Tumiatti, A. Prociani and V. Flanigan, "Solvent Extraction and Tandem Dechlorination for Decontamination of Soil," *Chemosphere*, **43**, 485-491 (2001).

M. Gehrke, S. Kapila, P. Nam, and V. Flanigan, "A High Efficiency All Glass Sampling and Concentration Device for Adsorptive Semivolatile Organics," *Chemosphere*, **43**, 479-483 (2001).

M. Gehrke, S. Kapila, P. Nam and V. Flanigan "Design of an Automated Rapid Vapor Concentrator and its Application in Nitroaromatic Vapor Sampling" *Chemosphere*, (2000)

P. Nam, Q. Liu, S. Kapila, W. Tumiatti and A. Porciani, "Assessment of Radiolysis and Chemical Dehalogenation for Decontamination of PCBs and PCDDs in Soil." *Organohalogen Compounds*, Vol. 40, 507-511, (1999).

J.W. King and K.S. Nam, "Coupling Enzyme Immunoassay with Supercritical Fluid Extraction", In *Immunoassays for Residue Analysis: Food Safety*, Ross C. Beier and Larry H. Stanker, Eds., *American Chemical Society*, Washington, DC, ACS Symposium Series No. 621, pp. 422-438 (1996)

Snyder, J.W. King, and K.S. Nam, "Determination of Volatile and Semivolatile Contaminants in Meat by Supercritical Fluid Extraction / Gas Chromatography / Mass Spectrometry", *J. Sci. Food Agric.*, **72 (1)**, 25-30 (1996)

K.S. Nam and J.W. King, "Supercritical Fluid Extraction and Enzyme Immunoassay for Pesticide Detection in Meat Products", *J. Agric. Food Chem*, **Vol. 42 (7)**, pp. 1469-1474 (1994)

## Patents:

Three Patents No. 6,800,318 (October 2004), No. 6,793,951 (September 2004), and No. 6,547,987 (April 2003), "Solvent and Method for Extraction of Triglyceride Rich Oil",

Patent No. 6,605,590 (August 2003), "Oligomers and Oligomeric Segments of  $\alpha$ -hydroxy Carboxylic Acids and  $\alpha$ -amino Acids and Uses in Improving Bioavailability of Nutrition Supplement for Ruminants"

Patent No. 6,342,651 (January 2002), "Reductive Combustion of Ammonium Salts of Sulfuric Acid"

Patent No. WO 2002088667, PCT Int. Appl. (2002), "Enantioselective oligomerization of  $\alpha$ -hydroxy carboxylic acids and  $\alpha$ -amino acids, especially for rumen bypass and delayed digestion"

## Selected Publications:

Alleti, Ramesh; Oh, Woon Su; Perambuduru, Meher; Afrasiabi, Zahra; Sinn, Ekkehard; Reddy, V. Prakash. Gadolinium triflate immobilized in imidazolium based ionic liquids: a recyclable catalyst and green solvent for acetylation of alcohols and amines. *Green Chemistry*, **7**(4), 203-206 (2005).

Reddy, V. Prakash; Alleti, Ramesh; Perambuduru, Meher K.; Welz-Biermann, Urs; Buchholz, Herwig; Prakash, G. K. Surya. gem-Difluorination of 2,2-diaryl-1,3-dithiolanes by Selectfluor and pyridinium polyhydrogen fluoride. *Chemical Communications* (Cambridge, United Kingdom), **(5)**, 654-656 (2005).

Alleti, Ramesh; Perambuduru, Meher; Samantha, Sampak; Reddy, V. Prakash. Gadolinium triflate: an efficient and convenient catalyst for acetylation of alcohols and amines. *Journal of Molecular Catalysis A: Chemical*, **226**(1), 57-59 (2005).

Beyaz, Ayse; Oh, Woon Su; Reddy, V. Prakash. Aggregational properties of sodium dodecyl sulfate in imidazolium-based quaternary salts. Abstracts of Papers, 228th ACS National Meeting, Philadelphia, PA, United States, August 22-26, (2004).

V. P. Reddy, M. E. Obrenovich, C. S. Atwood, G. Perry and M. A. Smith, "Involvement of Maillard Reactions in Alzheimer Disease," *Neurotoxicity Research*, **4**, 191-209 (2002).

V. P. Reddy and G. K. S. Prakash, "Electrophilic Reactions of Phenols," in *The Chemistry of the Functional groups*, ed., Z. Rappoport, John Wiley, New York, (2002), in press.

J. Madaj, Y. Nishikawa, V. P. Reddy, R. Rinaldi, T. Kurata and V. M. Monnier, "6-Deoxy-6-fluoro-L-ascorbic acid: Crystal structure and Oxidative Degradation," *Carbohydrate Research*, **329**, 477-485 (2000).

George A Olah, V. Prakash Reddy, Golam Rasul and G K Surya Prakash, "Search for Long-Lived 1,3-Carbocations and Preparation of the Persistent 1,1,3,3-Tetracyclopentyl-1,3,propanediyl Dication," *J. Am. Chem. Soc.*, **121**, 9994-9998 (1999).

G. A. Olah, V. P. Reddy and G. K. S. Prakash, "Friedel-Crafts Reactions," in *Kirk Othmer Concise Encyclopedia of Chemical Technology*, 4<sup>th</sup> Edition., John Wiley, New York, (1999).

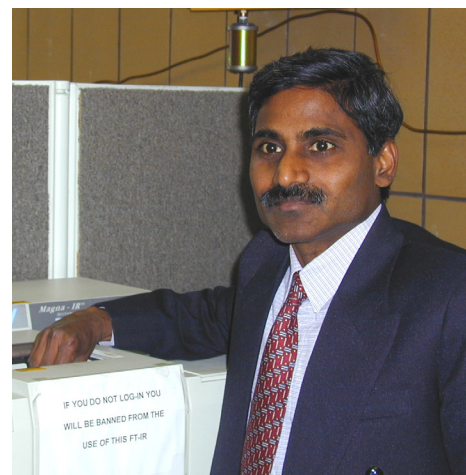
G. A. Olah, V. P. Reddy, G. Rasul, G. K. S. Prakash, "Search for Long-lived 1,3-Carbocations and Preparation of the Persistent 1,1,3,3-Tetracyclopentyl-1,3-propanediyl Dication," *J. Am. Chem. Soc.*, **121**, 9994-9998 (1999).

G. K. S. Prakash, V. P. Reddy, G. Rasul, J. Casanova and G. A. Olah, "The Search for Persistent Cyclobutylmethyl Cations in Superacidic Media and Observation of the Cyclobutylidicyclopentylmethyl Cation," *J. Am. Chem. Soc.*, **120**, 13362-13365 (1998).

G. A. Olah, V. P. Reddy, J. Casanova, G. Li and G. K. S. Prakash, "*trans*-Cyclopropane-1,2 bis(dicyclopentylmethyl) Dication, a Unique Cyclopropyl Stabilized Carbocation," *J. Org. Chem.*, **58**, 1639-1640 (1993).

S. Kantamneni, V. P. Reddy, G. Rasul, and G. K. S., Prakash, "Preparation, <sup>13</sup>C NMR, and IGLO/DFT Studies of Trifluoromethyl Substituted Allyl Cations," *Res. Chem. Intermed.*, **22**, 717-720 (1996).

J. Casanova and V. P. Reddy, "Electrochemistry of the Carbon-Halogen Bond," in *The Chemistry of Halides, Pseudo-halides and Azides*, eds., S. Patai and Z. Rappoport, John Wiley, New York, pp. 1003-1067 (1995).



## V. Prakash Reddy

preddy@mst.edu

Associate Professor

University of Hyderabad, M.Phil., 1979;  
Case Western Reserve University, Ph.D.,  
1986; Syracuse University, Postdoctoral  
Research Associate, 1986-1989

Research Interests: Organic and Physical  
Organic Chemistry

Our research interests are diverse and interdisciplinary, ranging from carbocation reaction mechanisms to organofluorine chemistry, environmentally benign ("green") chemistry, protein modifications and asymmetric Friedel Crafts reactions. This can be applied to drug design, understanding mechanisms of the aging process, and environmentally safe destruction of surplus chemical warfare agent stockpiles and other hazardous chemical materials.



## Thomas P. Schuman

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Associate Professor and Research Investigator of Materials Research Center University of Alabama in Huntsville, B.S., 1986; University of Alabama in Huntsville, M.S., 1989; University of Alabama in Huntsville, Ph.D., 1992; Shearwater Polymers, staff scientist, 1993, University of Southern Mississippi, postdoctoral fellow, 1993-1999. Member of the Federation of Societies of Coatings Technology, American Chemical Society.

Research Interests: Interfacial chemistry and spectroscopy of composites: coatings, covalent surface modifications and their role in nanoparticle-polymer composite performance, polymer synthesis and characterization, corrosion inhibition, adhesion, adhesion to plastic substrates, and adsorption.

Organic polymer composites, synthesized from custom-made polymers, are applied in structural, dielectric, and surface coating applications. Specifically, we desire to assess the structure-property relationships as the interface to material properties, which are assessed utilizing spectroscopic, microscopic, diffraction, mechanical, dielectric, and corrosion characterization tools. Our goal is to determine how the structure of the interface affects material behavior and, then, how to design the interfaces in order to optimize composite material performance.

### Selected Publications:

A. Shabeer, K. Chandrashekhara, and T. Schuman, "Synthesis and characterization of soy-based nanocomposites," *Journal of Composite Materials*, accepted July 2006.

Lynell Gilbert, Thomas P. Schuman, Fatih Dogan, Mike Krogh, "Dielectric Composites for High Power Density," *Advances in Electronic and Electrochemical Ceramics: Ceramic Transactions*, F. Dogan and P. N. Kumta (Eds), volume **179**, Baltimore, Maryland, 2005.

Y. Liu, M. J. O'Keefe, A. Beyaz, T. Schuman, "Synthesis and Characterization of Aluminum-Polyaniline Thin Films and Membranes," *Surface and Interface Analysis*, **37**, 782 (2005).

Ahmed Shahin, Fernande Grandjean, Gary J. Long, Thomas P. Schuman, "Cerium LIII-edge EXAFS Investigation of the Structure of Crystalline and Amorphous Cerium Oxides," *Chemistry of Materials*, **17(2)**, 315 (2005).

Thomas P. Schuman, "Protective Coatings for Aluminum Alloys," In: *Handbook of Environmental Degradation of Materials*, Myer Kutz, (Ed.), Chapter **17**, William Andrew Publishing, New York, 2005.

Thomas Schuman, Shelby F. Thames "Solvent Effects Producing Adhesion to Molded Polymer Surfaces," *Journal of Adhesion Science and Technology*, **19**, 1207-1235 (2005).

J. Shi, J.O. Stoffer, T.P. Schuman, "Ink Jet Printing Paper With Improved Waterfastness," *Journal of Coatings Technology Research*, **3**, 225 (2004).

Yasir Idlibi, Thomas P. Schuman, and James O. Stoffer, "Effect of phosphonic acid anion structure on the corrosion inhibition of steel by polyaniline." *Polymeric Materials Science and Engineering*, **88**, 3-4 (2003).

Thomas P. Schuman, Ahmed Shahin, and James O. Stoffer, "Cerium-based inhibitors of aluminum alloy corrosion," *Proceedings of the International Waterborne, High-Solids, and Powder Coatings Symposium*, 29th 371-382, (2002)

Scott Hayes, James O. Stoffer, Thomas J. O'Keefe, Thomas P. Schuman, Shantanu Patwardhan, Eric Morris, and Paul Yu, "SRET evaluation of cerium conversion coatings," *Polymeric Materials Science and Engineering*, **85**, 140-141 (2001).

Thomas P. Schuman and Shelby F. Thames, "Conductive powder coatings of emeraldine in epoxy polyester," in *Proceedings of the International Waterborne, High-Solids, and Powder Coatings Symposium*, 26th, pp. 318-335 (1999).

S.F. Thames and T.P. Schuman, "Conductive Powder Coatings of Emeraldine in Epoxy-Polyester," *Proceedings of the Twenty-sixth International Waterborne, High-Solids, and Powder Coatings Symposium*, University of Southern Mississippi, New Orleans, LA, (1999).



## Chariklia Sotiriou-Leventis

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Professor

University of Athens-Greece, B.S., 1982;  
Michigan State University, Ph.D., 1987;  
Northeastern University, Postdoctoral Fellow, 1987-89; Harvard University, Postdoctoral Fellow, 1989-92, Ciba Corning Diagnostics, Senior Research Scientist, 1992-93.

Research Interests: Organic Materials, Physical Organic and Bioorganic Chemistry.

In the area of organic materials: (a) We have synthesized for the first time Ru(II) Tris(1,10-phenanthroline)-Electron Acceptor Dyads using the 4-benzoyl-N-methylpyridinium cation and N-benzyl-N-methyl-viologen as intramolecular electron transfer quenchers, and we have incorporated them into silica aerogels for use as optical oxygen sensors. We found that the dynamic range, sensitivity and response time of these sol-gel based optical oxygen sensors were all improved (PRF funding); (b) We have developed mechanically strong silica aerogels without the need for supercritical fluid drying (filed a patent). We regard this discovery as one major step in the field of aerogels, because we have resolved the fragility problem that has prevented commercial use of this class of lightweight materials; (c) We have synthesized and studied new arylethynyl substituted 9,10-anthraquinones and Os(II) complexes as part of an effort to shift photoluminescence in the near-IR via substitution and via charge-transfer-modulated large Stokes shifts (NASA funding). In the area of physical organic chemistry, we have investigated multiple substitution effects and three-dimensional nonlinear free-energy relationships in the electrochemical reduction of substituted viologens and 4-benzoylpyridinium cations. In the area of bioorganic chemistry, we have investigated the reaction of radicals, such as superoxide and hydroperoxyl radicals with biomolecules (e.g.  $\beta$ -carotene, all-trans-retinol, etc.), in order to identify efficient radical traps as anticarcinogenic agents (NIH funding).

### Selected Publications:

Yang, J., Dass, A., Sotiriou-Leventis, C.; Tyson, D. S.; Leventis, N. "Synthesis and Near IR Photoluminescence of Os(II) Bis(2,2'-bipyridine) (3,8-Diarylethynyl-1,10-phenanthroline) complexes: Anomalous Behavior of the 3,8-Dinitrophenylethynyl-substituted Homologue," *Inorg. Chim. Acta*, **358**(2), 389-395 (2005).

Leventis, N.; Yang, J.; Fabrizio, E. F.; Rawashdeh, A.-M. M.; Oh, W. S.; Sotiriou-Leventis, C. "Redox-Active Star Molecules Incorporating the 4-Benzoylpyridinium Cation – Implications for the Charge Transfer Along Branches vs. Across the Perimeter in Dendrimers," *J. Am. Chem. Soc.*, **126**, 4094-4095 (2004).

Sotiriou-Leventis, C.; Yang, J.; Penggao, D.; Leventis, N. "Ru(II) Tris(3,8-dibromo-1,10-Phenanthroline)-A New Versatile Core for the Divergent Synthesis of Hyperbranched Systems," *Synth. Commun.*, **34**(19), 3491-3496 (2004).

Leventis, N.; Meador, M. A. B.; Zhang, G.; Dass, A.; Sotiriou-Leventis, C. "Multiple Substitution Effects and Three-Dimensional Non-Linear Free Energy Relationships in the Electrochemical Reduction of the N,N'-Dibenzylviologen and the 4-benzoyl-N-benzylpyridinium Cation," *J. Phys. Chem. B*, **108**, 11228-11235 (2004).

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P. Stavropoulos,\* R. Çelenligil-Çetin, S. Kiani, A. Tapper, D. Pinnareddy, P. Paraskevopoulou, "Iron, bis(pyridine)bis(2-pyridinecarboxylato-N1,O2)" in *Encyclopaedia of Reagents for Organic Synthesis*; Fuchs, P. (Ed.); Wiley: New York, 2006; pp 414–415.

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## Pericles Stavropoulos

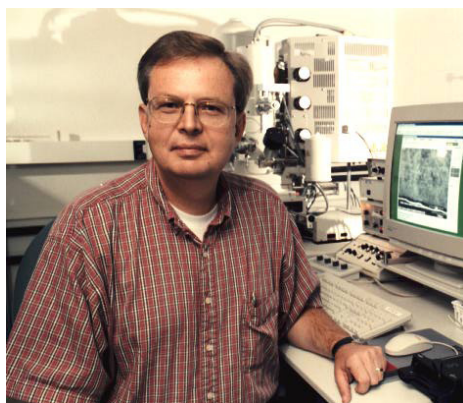
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Associate Professor

University of Athens, Athens, Greece, B.Sc. with Honors in Chemistry, 1982; Imperial College of Science and Technology, London, U.K. Ph.D, 1985; Universite Louis Pasteur, Strasbourg, France, Research Associate (EU Fellowship, 1988–89, Harvard University, Cambridge, MA, Postdoctoral Fellow, 1990–92.

Research Interests: Inorganic Chemistry, Inorganic Catalysis, Bioinorganic Chemistry. Organometallics

Most of our current work concentrates on hydrocarbon-oxidizing systems. Two major systems under investigation are iron-containing Gif-type reagents and assemblies relying on trinuclear copper core structures. This work has also been extended to include trinuclear ruthenium and rhenium clusters. Current effort is concentrated on providing detailed kinetic analysis of metal-dioxygen and metal-hydrogen peroxide interactions, including spectroscopic characterization of active intermediates. Reaction of these active oxidants with suitable hydrocarbons is also investigated under stoichiometric and catalytic conditions.



## Jay A. Switzer

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The Donald L. Castleman/Foundation for Chemical Research Missouri Endowed Professor of Discovery in Chemistry and Senior Research Investigator of Materials Research Center

University of Cincinnati, B.S., 1973; Wayne State University, M.A., 1975, Ph.D., 1979; Senior Research Chemist, Unocal Corp., 1979-87; Associate Professor, Materials Science, University of Pittsburgh, 1987-90.

Research Interests: Inorganic Materials Chemistry, Electrochemistry, Nanoscale Materials, Environmental Chemistry, Energy Conversion and Storage..

Our research is at the interface between chemistry and materials science. We use electrodeposition to produce ordered nanostructures such as superlattices of metal oxide semiconductors. We also are producing single crystal films using epitaxial electrodeposition. Our emphasis has been on metal oxide semiconductors with interesting optical, electrical, catalytic, or magnetic properties. The nanoscale materials we produce have quantum-confined properties which are a function of the physical dimensions of the material. Recently, we have electrodeposited chiral films, which may serve as sensors for biomolecules. We have also used biomineralization to produce chiral biomaterials. Students in the group become experienced in electrochemistry, scanning tunneling microscopy, atomic force microscopy, x-ray diffraction, and electron microscopy. They are well prepared for academic or industrial careers in electrochemistry, inorganic materials chemistry, or materials science.

### Selected Publications:

S. Boonsalee, R. V. Gudavarthy, E. W. Bohannon, and J. A. Switzer, "Epitaxial "Electrodeposition of tin(II) sulfide nanodisks on single-crystal Au(100)," *Chem. Mater.* **20**, 5737-5742 (2008).

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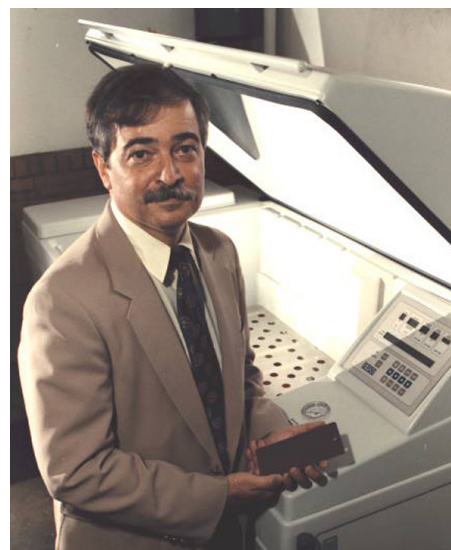
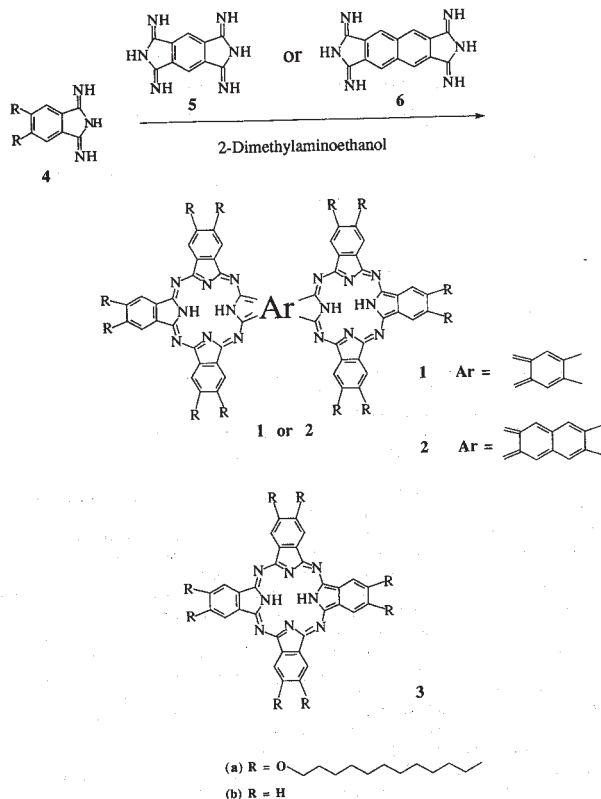
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E. Sianawati, P. Duncan, N. R. Mason and M. R. Van De Mark, "Development and Evaluation of a New Spectrophotometric Integration Technique for Flash Rust Stain Determinations," *J. Coatings Technology*, **65**, 45 (1993).

Jiang Yang and M. R. Van De Mark, "Synthesis of Binuclear Phthalocyanines Sharing a Benzene of Naphthalene Ring," *Tetrahedron Letters*, **34**, 5223 (1993).



## Michael R. Van De Mark

[mvandema@mst.edu](mailto:mvandema@mst.edu)

Director, Missouri S&T Coatings Institute,  
Associate Professor and Research Investigator of Materials Research Center  
Saginaw Valley State College, B.S., 1972;  
Texas A&M University, Ph.D., 1976; Colorado State 1977, University of Minnesota 1978, Postdoctoral Fellow, 1977, University of Miami, Faculty, 1978-85.

Research Interests: Polymer/Organic Electrochemistry, Coatings, Corrosion

Our current research efforts center on the synthesis, modification, utility, and characterization of water reducible polymers. These resins are useful for paints and coatings, particle size standards and environmental tracers. We are also continuing our work in the area of phthalocyanines. The synthesis and application of single and double ringed systems are of interest for laser dyes and for a fundamental study of potential two electron catalytic systems.



# Philip D. Whitefield

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Chairman, Professor, and Director of the Missouri S&T Center of Excellence for Aerospace Particulate Emissions Research (formerly UMR COE).

University of London - Queen Mary College, London, England, B.Sc.(Hons), 1975, Ph.D., 1979, Post-Doctoral Research fellow, Queen Mary College, 1978-1979, National Research Council Resident Research Associate (NRC/RRA) at the Air Force Weapons Laboratory (AFWL), 1979-1981, Scientist, McDonnell Douglas Research Laboratories, (MDRL), 1981-1990, Missouri S&T, 1990-present.

Research Interests: Physical/Analytical Professor Whitefield, currently leads an internationally recognized research program associated with the chemical and physical characterization of aerosols, the Missouri S&T COE, a Center of Excellence for Aerospace Particulate Emissions Research. As director of the Missouri S&T COE he coordinates a team of researchers from academia (Missouri S&T, MIT, Georgia Tech and University of Illinois, University of California - Riverside, the federal government, (NASA, FAA, DoD) and the private sector. In particular, he studies the aerosols generated by aerospace activities. This research program, initiated in 1990, has three major thrust areas - emissions measurement, interpretation of emissions measurements and the development of novel state of the art instrumentation tailored specifically to support the measurement and interpretation thrusts. This research has resulted in, to date, externally sponsored funding in excess of \$15 million.

## Selected Publications:

Wey, C. C., Anderson, B. E., Wey, C., Li-Jones, X., Winstead, E., Thornhill, K. L., Lobo, P., Hagen, D., Whitefield, P., Yelvington, P.E., Herndon, S. C., Onasch, T. B., Miake-Lye, R. C., Wormhoudt, J., Knighton, W. B., Howard, R., and Moses, C. A.. "Overview on the Aircraft Particle Emissions Experiment (APEX)", *Journal of Propulsion and Power*, September 2007.

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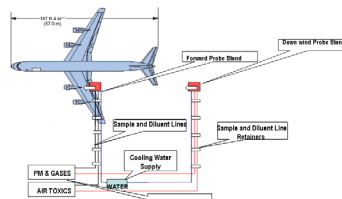
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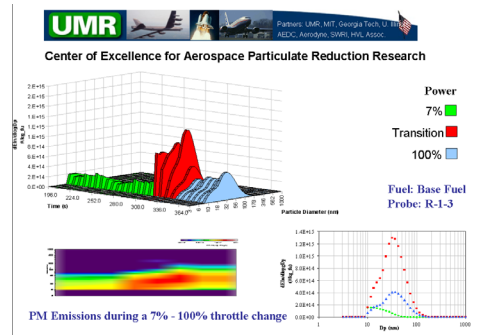
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M. N. Ross, D. W. Thoohey, W. T. Rawlins, E. C. Richard, K. K. Kelly, A. F. Tuck, M. H. Proffit, D. E. Hagen, A. R. Hopkins, P. D. Whitefield, J. R. Benbrook and W. R. Sheldon, "Observation of Stratospheric Ozone Depletion Associated with Mixed Propellant Rocket Emissions," *GRL*, **27**, 2209-2212, (2000).

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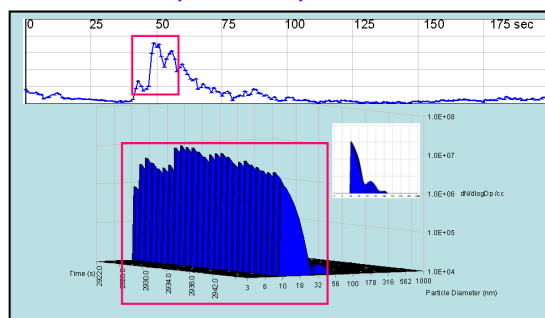


Configuration of Sampling Equipment During Aircraft Testing in Project APEX



### UMR Center of Excellence for Aerospace Particulate Reduction Research

#### B717 Departure - September 28, 2004



## Selected Publications:

Jeffrey G. Winiarz, "Enhancement of the Photorefractive Response Time in a Polymeric Composite Photosensitized with CdTe Nanoparticles," *J. Phys. Chem. C.*, **111**, 1904-1911 (2007).

Jeffrey G. Winiarz, F. Ghebremichael, Jayan Thomas, Gerald Meredith, Nasser Peyghambarian, "Dynamic correction of a distorted image using a photorefractive polymeric composite," *Opt. Express* **12**, 2517-2528 (2004).

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Bogdan Swedek, Ning Cheng, Yiping Cui, Jaroslaw Zieba, Jeffrey Winiarz, Paras N. Prasad, "Temperature-dependence studies of photorefractive effect in a low glass-transition-temperature polymer composite," *J. Appl. Phys.* **82**, 5923-5931 (1997).



## Jeffrey G. Winiarz

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Assistant Professor

State University of New York at Buffalo, B.S., 1997; State University of New York at Buffalo, Ph.D., 2003; United States Air Force Academy, Research Associate, 2002-4; University of Arizona, Visiting Scholar, 2004-2005.

Research Interest: Physical

Our research focuses on the development of various types of polymeric photonic materials and devices, with emphasis on photorefractive composites. The commercial practicality of these materials is currently restricted by their slow response time and limited spectral sensitivity. We are addressing these issues through a novel approach involving the photosensitization of these materials by way of the inclusion of surface-passivated semiconductor nanocrystals. Inorganic nanocrystals possess several advantages over their organic counterparts in that, through the use of relatively narrow band gap semiconductor materials, the spectral properties of the photosensitizing species can be extended to the technologically important wavelengths in the near-infrared region. Moreover, due to the highly efficient charge-generating properties associated with semiconductor materials, it is anticipated that these novel inorganic-organic hybrid nanocomposites can be fashioned such that their speed and sensitivity exceeds those associated with traditional all-organic composites.



## Klaus Woelk

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Associate Professor

University of Bonn, Ph.D. (1991)

Argonne Nat'l Laboratory (1992-1994)

University of Bonn (1994-2003)

### Research Motto:

“Science grows with communication.”

(Werner Heisenberg)

### Research Interests:

In situ NMR spectroscopy and imaging  
Homogeneous catalysis, supercritical fluids  
Soft-matter materials science

### Why are we doing what we are doing?

The curiosity about the processes of nature, the desire to explain everyday life phenomena, and the anticipation of a discovery that might improve the quality of our life is the driving force behind our research.

### Who needs supercritical catalysis?

The chemistry in supercritical carbon dioxide (scCO<sub>2</sub>) is part of our activities for establishing new pathways to control the activity and selectivity of catalytic reactions. The environmentally benign, reasonably available, and nontoxic scCO<sub>2</sub> exhibits solvent properties that are widely tunable by the supercritical density. In addition, no cumbersome downstream processing is needed after a reaction is completed, and the products are obtained free of hazardous solvent residues.

### What is Toroid Cavity NMR?

Toroid cavities detectors are coaxial resonators for NMR spectroscopy and imaging. We use modern in situ NMR techniques in toroid cavities to study chemical reactions and viscous fluids (gels, emulsions, polymers) under various conditions. Our award-winning autoclave probe (Fig.) is used, for example, to conduct the reactions in scCO<sub>2</sub>. Newly developed NMR imaging techniques are applied to viscous fluids and soft-matter materials to examine their dynamics as stationary or flowing materials. The goal of these studies is to improve existing and develop new materials.

### Selected Publications:

H. G. Niessen and K. Woelk, Investigations in Supercritical Fluids, in “In situ NMR Methods in Catalysis”, J. Bargon (ed.), *Topics Curr. Chem.* **276**, 69-110 (2007).

Th. Jonischkeit, U. Bommerich, J. Stadler, K. Woelk, H. G. Niessen, J. Bargon, Generating Long-lasting <sup>1</sup>H- and <sup>13</sup>C Hyperpolarization in Small Molecules with Parahydrogen-induced Polarization, *J. Chem Phys.* **124**, 201109 (1-5) (2006).

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H. G. Niessen, A. Eichhorn, K. Woelk, and J. Bargon, “Homogeneous Hydrogenation in Supercritical Fluids Mediated by Colloidal Catalysts,” *J. Mol. Catal. A*, **182-183**, 463-470 (2002).

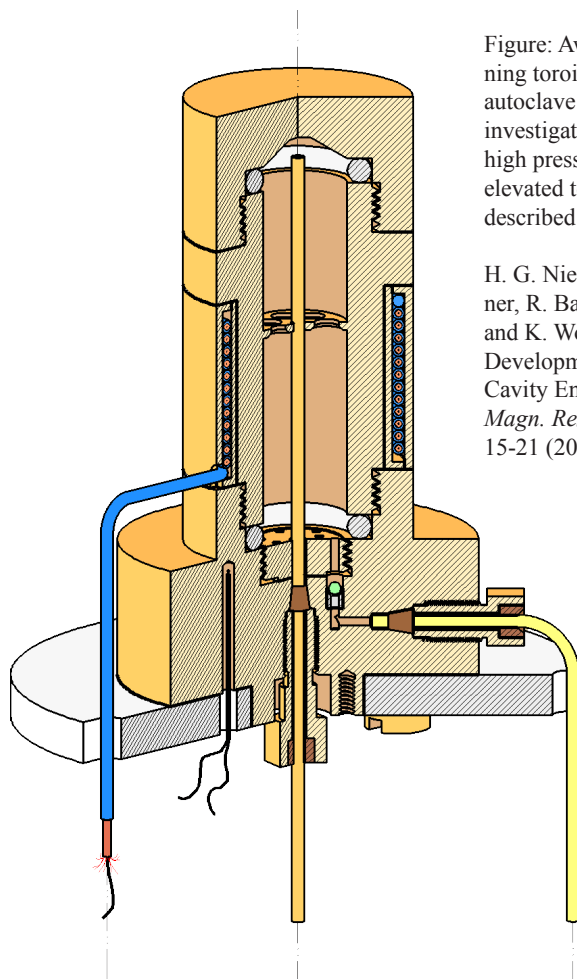
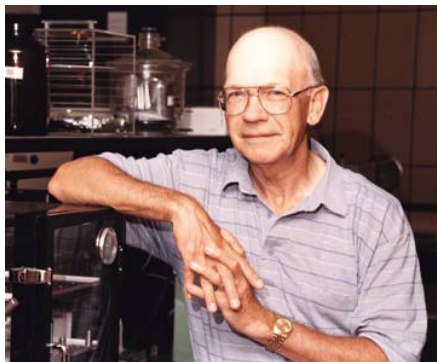


Figure: Award-winning toroid cavity NMR autoclave for in situ investigations under high pressures and elevated temperatures as described in:

H. G. Niessen, P. Trautner, R. Backhausen, and K. Woelk, “Recent Developments in Toroid Cavity Engineering,” *Magn. Reson. Eng.* **16B**, 15-21 (2003).

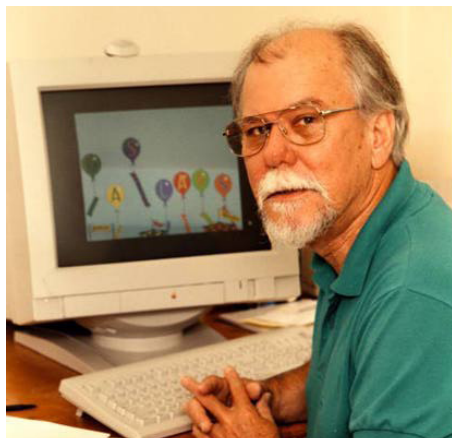
# EMERITUS, ADJUNCT PROFESSORS and LECTURERS



Donald W. Beistel

Associate Professor Emeritus  
Bucknell, B.S., 1958; University of Delaware, Ph.D., 1963. Physical Chemistry.

Spectroscopy and molecular structure, the physical chemistry of high energy compounds.



Gary L. Bertrand

Professor Emeritus  
McNeese State College, B.S., 1957; Tulane University, Ph.D. 1964. Physical Chemistry

Solution thermodynamics, solution calorimetry, solvation and solubilization phenomena, thermodynamics of chiral discrimination, thermodynamics of surfactant systems.



Louis Biolsi, Jr.

Professor Emeritus  
State University of New York at Albany, B.S., 1961, M.S. 1963; Rensselaer Polytechnic Institute, Ph.D., 1967. Theoretical Chemistry

The Kinetic theory of polyatomic gases, especially at high temperatures; practical thermophysical property calculations associated with atmospheric chemistry; accurate thermophysical calculations for small molecules.



Cynthia P. Bolon

bolonc@mst.edu  
Lecturer

Columbia College, B.F.A. and B.A. 2002, Ph.D., 2006. Nuclear Chemistry



Terry L. Bone

tbone@mst.edu  
Lecturer

University of Missouri-Rolla, B.S. 1976, M.S. 1979, Ph.D., 1990. Chemistry Education



Fred C. Hardtke

Assistant Professor Emeritus  
Oregon State University, Ph.D., Physical and Nuclear Chemistry.

Interaction of high-energy radiation with semi-conductor and dielectric materials and devices, space charge dissipation and electric formation in solid dielectrics, electrophoretic and polarographic measurements in charge-stabilized microemulsions.



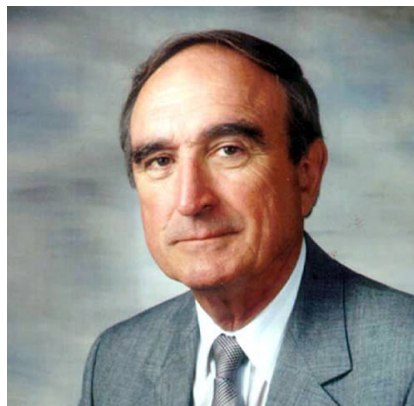
## David Hoiness

hoiness@mst.edu

Assistant Chairman, and Lecturer

St. Olaf College, B.S., 1957; Purdue University, M.S., 1960; Baylor University, Ph.D., 1964; U.S. Dept. of Agriculture, Postdoctoral Fellow, 1964-1966, Dupont Corporation--Research Chemist, 1966-1969, Pioneering Research Div.; Senior Research Chemist, 1969-1980, Industrial Fibers Div.; Research Assistant, 1980-1990, Kevlar™ Division; Laboratory Manager of DuPont Friction Materials Research & Testing Laboratory; Senior Research Associate, 1990-1993, Kevlar™ Division, Friction Materials, Friction Testing, Resins and Organic Chemistry.

Chemistry of friction materials, testing methodology for debris analysis, noise and vibration in automotive braking systems, film transfer mechanism during braking, dry molding technology, paper processes for production of wet friction papers, high speed photography of clutch burst process and mechanism development, electric charge of materials and its affect upon materials mixing processes, non-asbestos fiber reinforcement mechanism in friction processes, measurement of fibrous parameters and correlation to composite properties.



## William J. James

wjames@mst.edu

Professor Emeritus, Thomas Jefferson Fellow

Tufts University, B.S., 1949; Iowa State University, M.S., 1952, Ph.D., 1953, Néel Laboratoire de Magnetisme C.N.R.S, Grenoble France, Senior Fulbright Fellow, 1961-1962. Physical Chemistry.

Studies of the atomic and magnetic structures of rare earth transition metal compounds, their nano-composites thereof, superconducting compounds and magnetically ordered ferrites, manganites employing neutron and x-ray diffraction, mössbauer spectroscopy, and SQUID magnetometry. Magnetic and transport properties of nano-composite thin films of carbides, nitrides and oxides prepared by plasma-enhanced chemical vapor deposition.



## D. Vincent Roach

Associate Professor Emeritus

University of Missouri-Columbia, B.S., 1954, Ph.D., 1962. Physical Chemistry.

Gas-surface interactions, including experimental and theoretical investigations of energy exchange between gases and solid surfaces as well as of sorption of gases in solid surfaces. Free molecular, transition, temperature jump, and continuum gaseous heat conduction.



## Hector O. McDonald

Professor Emeritus

University of Arkansas, Ph.D. Physical Inorganic Chemistry.

Kinetics and mechanisms of inorganic compounds; synthesis and characterization of inorganic metal complexes; mass spectrometry; chemical vapor deposition of refractory materials, electrochemistry.



## B. Ken Robertson

Associate Professor Emeritus

West Texas State University, B.A., 1960; Texas A&M University, Ph.D., 1965. Physical and Analytical Chemistry

Crystal structure and magnetic and electrical properties of solids.



## Robert R. Russell

Professor Emeritus  
Kansas University, Ph.D. Organic Chemistry

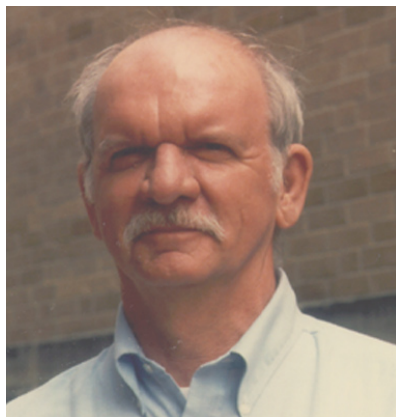
Organic reaction mechanisms, mechanisms of epoxide reactions, effects of steric inhibition on resonating systems, properties of tolans, thermochromism in organic compounds.



## Wilbur P. Tappmeyer

Professor Emeritus  
University of Missouri-Columbia, Ph.D.  
Inorganic Chemistry

Transition metal acetate solvates in pure acetic acid, structure of metal acetates in pure acetic acid and mixed solvents, coprecipitation of trace quantities of metal chelates.



## Donald J. Sizhr

Professor Emeritus  
University of Wisconsin, Ph.D.  
Biochemistry

Biochemistry of differentiation in fungi; fungal cell-wall biosynthesis; isolation and characterization of natural products particularly from fungi; use of fungi for converting biomass into chemical feedstocks, liquid fuels, and/or pharmaceuticals.



## Tadashi Tokuhiro

tadashi@mst.edu  
Adjunct Professor  
Tokyo College of Science, Tokyo, Japan, B.S., 1957; Tokyo Institute of Technology, M.S., 1959; Tokyo Institute of Technology, Ph.D., 1962; The Ohio State University, Postdoctoral Fellow, 1965-1969  
Chemical physics/Physical chemistry of NMR; Phase science, particularly for physicochemical principles of polymer gels; NMR imaging of bio-tissues.

NMR spin echo trains for exploring a new approach to high-resolution NMR spectroscopy, NMR relaxation theory for solvent molecules in polymer gels, thermodynamic study of polymer gels, science of boron shimming and boron recovery in the nuclear reactor, polymer gels applied to the low radio-active waste disposal. A new approach to the characterization of bio-tissues based on the theoretical analysis of proton NMR relaxation data of water and eventual application to NMR imaging of the human body.



## James O. Stoffer

jstoffer@mst.edu  
Curators' Professor Emeritus and Senior Research Investigator of Materials Research Center Mount Union College, B.S., 1957; Purdue University, Ph.D., 1961; Cornell University, Postdoctoral Fellow, 1961-1963. Polymer Synthesis and Characterization:

Chemistry of the polymer-substrate interface; corrosion protection, paint research; polymer synthesis; transparent composites; ultrasonic and microwave polymerizations; ultrasonic pigment dispersion.

## Adjunct Professors

Dr. Zahra Afrasiabi Navan

Dr. Terry L. Brewer

Dr. Tony D. Flaim

Dr. Fernande Grandjean

Dr. H. Neal Grannemann

Dr. Richard H. Matthews

Dr. Charles Jody Neef

Dr. Xie Shao

Dr. Gu Xu

Dr. William Yelon

## GRADUATE COURSES

300 Special Problems (IND 0.0-6.0) Problems or readings on specific subjects or projects in the department. Prerequisite: Preceded or accompanied by Chem. 4 or an equivalent training program approved by Missouri A&T. Consent of instructor required.

301 Special Topics (Variable 0.0-6.0) This course is designed to give the department an opportunity to test a new course. Variable title.

305 Advanced Chemical Preparations And Techniques (LEC 1.0 and LAB 2.0) A course designed to develop facility in the use of equipment and techniques commonly used in advanced work in experimental chemistry. Prerequisite: Preceded or accompanied by Chem. 4 or an equivalent training program approved by Missouri S&T.

310 Undergraduate Seminar (RSD 1.0) Written and oral presentations of current topics in chemistry. This course may serve as part of the capstone requirement for chemistry majors.

321 Intermediate Organic Chemistry I (LEC 3.0) An advanced course designed to give the student a mastery of the fundamentals of organic chemical reactions and theory. Prerequisites: Chem. 223 and 243.

323 Intermediate Organic Chemistry II (LEC 3.0) A systematic study of organic reactions, their mechanisms and synthetic applications. Prerequisites: Chem. 223 and 243.

325 Industrial Chemical Processes (LEC 3.0) Detailed study of various industrial chemical manufacturing processes including underlying chemistry, reaction pathways and separation processes. Prerequisite: Ch Eng 235 or Chem. 221, or graduate standing. (Co-listed with Ch Eng 389)

328 Organic Synthesis And Spectroscopic Analysis (LEC 1.0 and LAB 2.0) Advanced methods for the multistep synthesis and characterization of organic compounds. Modern instrumental methods of identification of organic compounds. Prerequisites: Chem. 4, Chem. 223, Chem. 228.

331 Selected Topics In Inorganic Chemistry (LEC 3.0) A study of inorganic chemistry with emphasis on physical methods. General subjects covered include: molecular structure, bonding, complexes, spectroscopy, and reaction rates.

338 Advanced General Chemistry For Secondary Teachers (LEC 3.0 and LAB 1.0) A study of the general principles of chemistry with emphasis on the fundamental laws and their application in practical applications. The laboratory experiments are designed to support lectures and to be used as teaching demonstrations in high schools. Prerequisite: One year of college chemistry.

343 Introduction To Quantum Chemistry (LEC 3.0) A study of molecular structures and spectroscopy, statistical thermodynamics, kinetic theory, chemical kinetics, crystals, and liquids. Prerequisites: Math 22 & Physics 25 or equivalents.

344 Advanced Physical Chemistry (LEC 3.0) Advanced undergraduate treatments of special topics of physical chemistry, which may include statistical mechanics, kinetics, group theory, or spectroscopy. Prerequisite: Chem. 343.

346 Chemical Thermodynamics (LEC 3.0) A study of the laws of thermodynamics with application to chemical systems. Emphasis is placed on partial molal functions. Prerequisite: Chem. 243.

349 The Physical Chemistry Of Colloidal Dispersions (LEC 3.0) The stability of colloidal systems is treated using the kinetic approach with interparticle potentials. The results are extended to practical systems of microemulsions, emulsions and foams. Prerequisite: Chem. 343.

351 Advanced Analytical Chemistry (LEC 3.0) Theoretical and practical aspects of modern analytical chemistry. Prerequisite: Chem. 251.

355 Instrumental Methods Of Chemical Analysis (LEC 3.0 and LAB 1.0) Principles and analytical applications of molecular spectroscopy, chromatographic separations, mass spectrometry, and radiochemistry. A brief overview of instrument electronics, signal generation and processing, and automated analysis is also provided. Prerequisites: Chem. 4, Chem. 52, Chem. 223, Chem. 243.



- 361 General Biochemistry (LEC 3.0) A resume of the important aspects of quantitative and physical chemistry in biochemical processes. General subjects covered include: proteins, nucleic acids, enzymes, carbohydrates and lipids. Prerequisite: Chem. 223 and Bio 211.
- 362 General Biochemistry Laboratory (LAB 2.0) Experiments are integrated with the lectures and cover the chemical and physical properties of proteins, enzymes, nucleic acids, carbohydrates and lipids. Prerequisites: Preceded or accompanied by Chem. 361 and Chem. 4 or an equivalent training program approved by Missouri S&T.
- 363 Metabolism (LEC 3.0) A continuation of Chem. 361. Catabolism and anabolism of carbohydrates, lipids, proteins, and nucleic acids. Photosynthesis, oxidative phosphorylation and membranes. Prerequisite: Chem. 361 or Chem. 225; Chem. 227.
- 367 Industrial Biochemistry (LEC 3.0) A study of the problems involved in the utilization of biological systems for the production of bulk chemicals, the preparation of biological and the treatment of waste from plants producing biological and foodstuffs. Prerequisite: Junior standing.
- 371 Nuclear And Radiochemistry (LEC 3.0 and LAB 1.0) A study of the fundamentals of nuclear and radiochemistry including properties of radiations; effect of radiation on materials, production, measurement and use of radioactive tracers; and the chemistry of reactor materials. Laboratory training includes radiochemistry technology. Prerequisites: Physics 107 or 207 and preceded or accompanied by Chem. 4 or an equivalent training program approved by Missouri S&T.
- 373 Atmospheric Chemistry (LEC 3.0) A chemical study of the troposphere including composition; nucleation, growth stability, distribution, diffusion, and fallout of aerosols; and meteorological aspect. Prerequisite: Chem. 243.
- 375 Principles Of Environmental Monitoring (LEC 3.0) This course provides an overview of environmental monitoring methodologies. Discussion covers thermodynamic and kinetic processes that affect chemical transport and fate in the environment. Federal environmental regulations and remediation technologies are also covered with specific examples. Prerequisites: Chem. 221, Physics 25.
- 381 Chemistry And Inherent Properties Of Polymers (LEC 3.0) A basic study of the organic chemistry of natural and synthetic high polymers, their inherent properties and their uses in plastic, fiber, rubber, resin, food, paper and soap industries. Prerequisite: Chem. 223.
- 384 Polymer Science Laboratory (LEC 1.0 and LAB 2.0) Lectures and laboratory experiments dealing with polymerization reactions, solution properties and bulk or solid properties will be presented. Each student will prepare polymers and carry out all characterization experiments on actual samples. Prerequisite: Chem. 381 or Ch Eng 375, preceded or accompanied by Chem. 4 or an equivalent training program approved by Missouri S&T.
- 385 Fundamentals Of Protective Coating I (LEC 3.0) Study of the basic principles of protective coatings with particular reference to the paint and varnish industry. Classifications, manufacture, properties and uses of protective coatings. Prerequisite: Chem. 223.
- 390 Undergraduate Research (IND 0.0-6.0) Designed for the undergraduate student who wishes to engage in research. Does not lead to the preparation of a thesis. Not more than six (6) credit hours allowed for graduation credit. Subject and credit to be arranged with the instructor. Preparation of a written, detailed report is required of the student. Prerequisite: Must meet departmental requirements for instruction in laboratory safety. Consent of instructor required.
- 400 Special Problems (IND 0.0-6.0) Problems or reading on specific subjects or projects in the department. Consent of instructor required.
- 401 Special Topics (Variable 0.0-6.0) This course is designed to give the department an opportunity to test a new course. Variable title.
- 410 Seminar (RSD 0.0-6.0) Discussion of current topics.
- 421 Advanced Organic Chemistry (LEC 3.0) An advanced study of organic chemistry including name reactions and current theory. Prerequisite: Chem. 223.
- 423 Advanced Synthetic Organic Chemistry (LEC 3.0) A discussion of a large number of synthetically useful reactions involving enolates and enamines; nucleophilic additions to carbonyl compounds; functional group interconversions, thermal pericyclic reactions; organometallic compounds; carbocations, carbenes and free radicals as reactive intermediates; aromatic substitutions; and multistep synthesis. Prerequisite: Chem. 321 or equivalent.
- 425 Physical Organic Chemistry (LEC 3.0) An advanced course in theoretical organic chemistry treating molecular orbital theory, free energy relationships, transition state theory, and other fundamental topics. Prerequisite: Chem. 321.
- 431 Inorganic Reaction Mechanisms (LEC 3.0) A study of the reaction mechanisms of inorganic compounds involving both metallic and non metallic elements. The topics covered include, substitution, exchange, oxidation-reduction and electron transfer reactions in inorganic systems. Prerequisite: Chem. 237 or Chem. 331.
- 432 Bioinorganic Chemistry (LEC 3.0) Metallo biomolecules, including metalloenzymes and other metalloproteins; oxygen carriers; iron transport and other iron proteins; copper proteins; cancer agents and cures; nitrogen-fixation, etc. Prerequisite: Chem. 331.
- 435 Principles Of Inorganic Chemistry (LEC 3.0) A systematic study of modern and theoretical inorganic chemistry, based on the periodic classification. Prerequisites: Chem. 237, Chem. 331 and Chem. 343.
- 436 X-ray Crystallography (LEC 2.0 and LAB 2.0) Molecular and crystal structure determination by single crystal x-ray diffraction methods. Brief coverage of relation to neutron and electron diffraction.
- 437 Principles Of Inorganic Chemistry (LEC 3.0) A continuation of Chem. 435 with special emphasis on the transitional elements. Prerequisites: Chem. 237, Chem. 331 and Chem. 435.
- 438 Inorganic Materials Chemistry (LEC 3.0) Chemical processing of solid materials. Introduction to point groups, space groups, and x-ray diffraction. Bonding in solids - from molecular orbital theory to band theory. Nonstoichiometric materials and Kroger-Vink notation. Optical and electrical properties of semiconductors. Epitaxial growth. Quantum effects in nanophase materials. Prerequisite: Chem. 331 or permission of instructor.
- 440 The Physical Chemistry Of Colloidal Dispersions (LEC 3.0) A study of the properties of colloidal systems. Prerequisite: Chem. 243.
- 441 Physical Chemistry Of Surfaces (LEC 3.0) Absorption at liquid interfaces and properties of surface films. Physical and chemical absorption on solid surfaces. Catalysis.
- 442 Neutron Diffraction (LEC 3.0) A study of neutron diffraction techniques as applied to nuclear and magnetic structures of alloys, compounds, single crystal and polycrystalline materials. Prerequisites: Physics 25 and 26.
- 443 Advanced Chemical Thermodynamics (LEC 3.0) Partial molar enthalpy and free energy. The third law of thermodynamics measurement of absolute entropy and correlation of thermodynamic properties. Microscopic and macroscopic theory of non-equilibrium thermodynamics. Prerequisite: Chem. 243.

- 444 Spectroscopy (LEC 3.0) Introduction to the interaction of electromagnetic radiation with matter. Emphasis on the ultraviolet, visible, and radio portions of the spectrum. Prerequisite: Chem. 343 or equivalent.
- 445 Quantum Chemistry I (LEC 3.0) A rigorous introduction to the fundamental concepts and principles of quantum chemistry. Application to translational, vibrational, and rotational motion; one-electron systems. Prerequisite: Chem. 343 or equivalent.
- 446 Quantum Chemistry II (LEC 3.0) Atomic and molecular quantum mechanics. Emphasis on self-consistent field, variational, and perturbation theories. Introduction to approximate methods. Prerequisite: Chem. 343 or equivalent.
- 447 Statistical Thermodynamics (LEC 3.0) Derivation of the partition function and its application to chemical systems. Prerequisite: Chem. 243.
- 449 Chemical Kinetics (LEC 3.0) An introduction to the deduction of mechanisms of homogeneous chemical reactions from rate-data. Selected topics, such as photochemistry, free-radical mechanisms, catalysis, and explosion reactions. Prerequisite: Chem. 243.
- 451 Advanced Quantitative Analysis (LEC 3.0) A study of the quantitative analysis of the chemical elements based on their periodic arrangement and group separations. Emphasis is placed on the analysis of the less common elements. Prerequisite: Chem. 251.
- 453 Separations (LEC 3.0) An in-depth study of all types of analytical and preparative-scale separations. A special emphasis will be placed on chromatography and chromatographic theory. Prerequisite: Chem. 355 or equivalent.
- 455 Chemical Spectroscopy (LEC 3.0) A study of the electronic, vibrational, rotational and nuclear magnetic resonance spectra of atoms and molecules. A basic understanding of the underlying theoretical principles and the interpretations of results is stressed. Prerequisite: Chem. 355, Chem. 343 or equivalent courses.
- 457 Electrochemistry (LEC 3.0) Introduction to the fundamentals, methods and applications of electrochemistry. Fundamentals cover the thermodynamics/kinetics of electrode reactions, and the modes of mass transport in the electrolyte. Methods cover potentiometric, amperometric, and a.c. techniques. Applications focus on analysis and study of materials. Prerequisite: Chem. 243.
- 458 Principles And Applications Of Mass Spectrometry (LEC 3.0) The course covers fundamental physical principles of mass spectrometry, instrumentation, interpretation of spectra, and applications in environmental, polymer, biomedical, and forensic fields. Prerequisite: Chem. 251 or equivalent.
- 464 Free Radicals In Biochemistry (LEC 3.0) The study of the basic principles of free radical chemistry and biochemistry. Prerequisites: Chem. 221, Chem. 223 and Bio Sci 211.
- 465 Enzymology (LEC 2.0 and LAB 1.0) The study of the chemical and physical properties, mechanisms of action, and commercial uses of enzymes. Laboratory experiments are designed to illustrate the catalytic properties of enzymes. Prerequisites: Chem. 361 and 362.
- 467 Intermediary Metabolism And Biosynthesis (LEC 3.0) The course covers the biosynthesis and metabolism of nucleic acids, carbohydrates, lipids and proteins. Prerequisite: Chem. 363.
- 468 Advanced Biochemical Techniques (LAB 2.0) Offers training in techniques and manipulation of equipment, sterile procedures, isolation and identification of biochemical material. Prerequisite: Chem. 362.
- 471 Advanced Nuclear Chemistry (LEC 3.0) A study of the production and decay of nuclei, radioactive dating techniques, and the abundance and origin of the chemical elements. Prerequisites: Chem. 371, Physics 107 or 207.
- 472 Radiation Chemistry (LEC 3.0) A study of the chemical and physical effects of high energy radiation in nonmetallic fluids, gases, liquids, and solids. Prerequisite: Chem. 371, Physics 107 or 207.
- 484 Polymer Physical Chemistry And Analysis (LEC 3.0) A study of the physical properties of macromolecular systems including polymer solutions, gels, bulk polymers and rubbers. The chemical characterization of polymers based on their thermal, spectroscopic, microstructure and molecular weight is also discussed. Prerequisites: Chem. 223 and Chem. 243.
- 486 Inorganic Polymers (LEC 3.0) A basic study of inorganic natural and synthetic polymers, their formation and reactivity, their inherent properties, methods of characterization and applications. Prerequisite: Chem. 237 or equivalent.
- 490 Research (IND 0.0-15.0) Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Prerequisite: Must meet departmental requirements for instruction in laboratory safety. Consent of instructor required.
- 493 Oral Examination (IND 0.0) After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.
- 495 Continuous Registration (IND 1.0) Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.
- 497 Theory Of Chemical Research (LEC 3.0) The design of research experiments in various subfields of chemistry and the evaluation of research results with the aid of examples taken from the current literature.

# Missouri University of Science and Technology Application Procedure For Graduate Applicants

The following is needed to apply for graduate school:

Graduate Application

Application for Graduate Appointment

Official Transcripts (above high school) covering all credits to date

Official GRE scores. Departments normally require 1100 or greater (analytical and quantitative old GRE) or Q 600 and WR 3.0 (new GRE test) to be considered.

Official TOEFL score (International students only). Departments normally require 550 or greater to be considered.

Three Letters of Recommendation in sealed envelopes

Statement of Purpose

Financial Statement (International students only).

\$50.00 Application Fee