### Dr. David Boatright

Phase-transfer catalysis (PTC) is a powerful technique that is applied to an ever increasing array of chemical reactions in 40 reaction categories. The most important parameters which determine the reactivity and selectivity of PTC systems are catalyst, solvent and hydration. Although much empirical work has been performed characterizing the effects of catalyst structure, solvent and hydration on reactivity, very little work has been performed to elucidate the underlying fundamental structure-activity relationships (SAR's). Empirical guidelines have been suggested for choosing catalyst structure, solvent and hydration, however, in the absence of a deep understanding of the underlying fundamentals, these guidelines are rough at best. This leads to the loss of valuable time and money for businesses trying to apply PTC to their commercial processes. Through a close collaboration with PTC Organics, Inc., I am investigating the relationships between catalyst structure, solvent and hydration and reaction efficiency.

### Dr. Sharmistha Basu-Dutt

I am interested in inter-disciplinary projects in applied science relevant to the Engineering Studies major. In one project, student study factors that control the efficiency of solar cells. In another project, students build fuel cells, and manipulate design parameters to study their effects on the operation of these cells. I am involved in developing nanotechnology based activities that can be used in lower and upper level chemistry courses. On activity currently being developed involves using spectroscopy to study structural characteristics of single walled nanotubes. I am actively participant in science education projects. In collaboration with Dr. Gail Marshall in the Department of Curriculum and Instruction, professional development workshops are offered for K-12 teachers in the area of learning and teaching science by the inquiry method.

### Dr. Megumi Fujita

My research interest is transition metal-catalyzed environmentally friendly organic reactions. My current research focus is to develop transition metal complexes that catalyze selective oxidation of organic compounds by nitrous oxide ($N_2O$) and hydrogen peroxide ($H_2O_2$). These "green" oxidants would generate only non-toxic byproducts, nitrogen ($N_2$) and water ($H_2O$), respectively, after consumption as oxidants. We synthesize new tridentate and tetradentate ligands as scaffolds for selected first-row, late transition metal ions to create $N_2O$- and $H_2O_2$-activation site.

### Dr. Anne Gaquere-Parker

My background is in organic chemistry, however during my PhD I started to look at the use of ultrasounds to enhance the reaction rates. Since it gave me good results, I am very keen on this technique and now I am using ultrasounds everywhere! In my research laboratory, students study how ultrasounds can be used to accelerate the degradation rate of persistent harmful pollutants. As you can see, little by little I have become a sonochemist with an emphasis on environmental chemistry. Nothing is set in stone…I am also very interested in nanotechnology and especially the study of fullerenes, carbon nanotubes, their behavior in organic solvents and their possible chemical functionalization.

### Dr. Lucille B. Garmon

I am a physical chemist with interests in general chemical education as well as in the history and philosophy of science. My research right now is in the field of chemical education. In the Fall of 1998, I started a project on using a "Workshop" format to help students master general chemistry. The workshops are groups of 8 or 9 students who meet weekly to go over sets of assigned questions and problems. A number of undergraduate students are involved as peer leaders of the workshops. Results of the project will be used to improve student understanding of material, attitudes toward chemistry, and retention in future chemistry courses.

### Dr. Victoria J. Geisler

A current research project explores nitration techniques that re regioselective, high yielding and reduce the large amounts of corrosive acids that are traditionally used. The method currently being investigated is the use of catalyst sulfuric acid supported on silica-gel. This method has been applied in collaboration with Professor Khan and our students to the nitration of polyaromatic hydrocarbons (PAH). Our current highly regioselective syntheses are a viable means for synthesizing nitro-derivatives of PAH that are formed in combustion processes, as well as in atmospheric reactions of PAH in ambient air with pollutants such as $NO_2$ and $HNO_3$. Undergraduates who wish to work on this project will learn synthesis, separation and characterization techniques.

### Dr. John E. Hansen

I am an experimental physical chemist interested in studying the dynamics of chemical and biological systems using optical and laser spectroscopy. A major focus in my group is to determine the folding pathway a polypeptide chain will follow to finally arrive at a unique three dimensional protein structure. Dynamical processes I am studying include electron transfer, proton transfer and protein folding.

### Dr. Farooq A. Khan

A physical chemist by training, I am working in two broad areas, reactivity of carbon cluster ions using a time-of-flight mass spectrometer, and reactivity of carbon nanotubes and fullerenes using optical and mass spectrometric techniques. While the goal of this work is to carry out publishable work on current problems, there is considerable emphasis on providing undergraduate students a meaningful experience in current, cross-disciplinary work with modern instrumentation.

### Dr. Partha S. Ray

I am an Organic Chemist with research interests in medicinal and synthetic chemistry. The ultimate goal in my research is to discover new anti-tumor and anti-microbial agents by chemical synthesis. We have undertaken this exciting and challenging journey with the anticipation that along the way to our destination we will discover and develop new synthetic methods and establish structure-activity relationships. We are particularly interested in the designs and synthesis of novel inhibitors of folate requiring enzymes, which play critical roles in the biosynthesis of DNA. Our research is funded primarily by the National Cancer Institute.

### Dr. Spencer J. Slattery

Transition metal molecules are essential components in fundamental biological processes such as cellular respiration, photosynthesis, as well as in a variety of enzymatic activity. They are the backbone of catalytic process which can be utilized in not only the biological sense, but also in light harvesting systems, fuel cells, and molecular electronics. What's particularly key about these molecules and what triggers the specific behavior necessary in these various processes, however, is the structural position which surrounds the metal. The coordinated moleculars (ligands) are active players in dictating the characteristic behavior of the metal center. Our lab has previously observed regulated redox and spin state properties due to systematic inductive and steric modifications of the coordinated ligands on monometallic first row transition metal complexes. We have also synthesized novel ligands which contain an ionizable proton site in order to study proton coupled electron transfer behavior in first and second row transition metal complexes. Utilizing this knowledge, my current research directive has become multifaceted. One, we want to develop first row metal complexes which utilize these novel ligands in order to reversibly manipulate spin transition by the loss/gain of an acidic hydrogen. Secondly, we are studying the extent that ligand substituent inductive effects influence the absorbance and fluorescing properties of chromium systems. In addition, we are also developing novel bridging ligands with ionizable proton sties which will be used to link first row transition metals, to study the extent of spin-spin coupling between the metal centers, as well as how the coupling properties can be regulated via subtle changes in the bridge structure.

**Dr. Douglas Stuart**

I am a bioanalytical chemist with a research focus on the development and design of novel nanoparticle based methods of ultra-sensitive biomedical and environmental detection and analysis. Specifically, I exploit the unique optical properties of gold and silver structures such as intense absorption, wavelength selective photon scattering, localized surface Plasmon resonance (LSPR), and the ability to support surface-enhanced Roman scattering (SERS). An important part of this research is the systematic investigation of the fundamental relationships between a particle's physical properties (size, shape, composition) and its observed optical properties.

**Department of Chemistry**
**Research General Interest Areas**

Drug Design and Synthesis
Surface Chemistry
Computer Assisted Molecular Modeling
Environmentally Benign Synthesis
Protein Folding and Recognition
Chemical and Biological Dynamics
Organic Synthetic Methodology
Transition Metal Chemistry
Laser Spectroscopy
Mass Spectrometry
Teaching Innovations


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**Dr. Spencer J. Slattery, Chair**


# Step Into The Future

# Chemistry Research

**The chemistry faculty believes that research can be one of the most important educational experiences for our students.**

**Independent study provides the opportunity for the student to learn new laboratory techniques and explore the unknown using research methodology. They also get hands-on experience with modern instruments. More than any other experience, it allows the student to engage in the creative process, and to gain confidence, discipline and independence. Every faculty member in the department of chemistry is actively involved in research.**