GRADUATE PROGRAM

CHEMISTRY
Welcome to the Department of Chemistry at Boston College. Our department is a dynamic research community comprised of nearly 200 scientists studying all phases of contemporary chemical science, including many interdisciplinary areas interfacing with the fields of biology, medicine, physics and materials science. More than 100 graduate students, 40 undergraduate majors and 25 postdoctoral fellows work hand in hand with approximately 20 internationally recognized and acclaimed faculty members advancing the frontiers of chemistry. In addition, we annually host a diverse seminar series that brings outstanding visiting scientists from around the world to campus for formal and informal interactions with all members of the department.

Recent achievements of the scientists in the Department of Chemistry reflect our exciting research culture. In the last year, more than 70 research papers were published by BC chemists in internationally recognized journals, including *Nature*, *Science*, *Nature Chemistry*, *Nature Chemical Biology*, *Journal of the American Chemical Society* and *Angewandte Chemie*; the overwhelming majority of these papers were co-authored by our graduate students. Each year, we celebrate the accomplishments of our students with a Graduate Student Research Symposium, a daylong event featuring seminars and poster presentations by our graduate student colleagues.

Many of our graduate students have obtained prestigious fellowships, including those sponsored by the American Chemical Society, the Department of Education, the National Institutes of Health, the National Science Foundation, the Department of Energy, NASA and the pharmaceutical industry. In addition, graduates of the department have gone on to assume positions of scientific leadership in private industry as well as in some of the finest academic institutions in the world.

For a genuine appreciation of the exciting atmosphere of the department and the outstanding facilities that provide the setting for our research, we strongly encourage you to view our website or plan a campus visit. We would be happy to arrange individual meetings with faculty and students so that you can get a firsthand sense of the vibrant scientific environment of our department. For more information, please e-mail us at chemadmissions@bc.edu.
Ph.D. Program

Coursework
First-year course requirements provide students with a breadth of knowledge in the traditional fields: organic, chemical biology, physical chemistry and inorganic chemistry. While a specific number of credits is not required for the Ph.D., students are encouraged to pursue a program of studies—with the approval of their advisor—that is consistent with their individual educational goals.

Selection of a Research Advisor
During the first semester of graduate studies, students meet with faculty members and advanced graduate students to explore the dissertation project opportunities available in various research groups. The Graduate Student Research Symposium, held in October, showcases the research of our graduate students in a daylong event that consists of oral and poster presentations. The symposium is an excellent opportunity for new graduate students to learn more about research activities in the department. By the end of the first semester, most students have selected a research advisor and identified a potential dissertation project that they will begin investigating in the second semester.

Teaching Requirements
Some teaching or equivalent educational experience is required. This requirement may be satisfied by at least one year of service as a teaching assistant or by other suitable teaching duties. Arrangements are made with each student for a teaching program best suited to their overall program of study. Waivers of teaching requirements may be granted under special circumstances with the approval of the Department of Chemistry.

Comprehensive Examinations
At the end of the second year, Ph.D. students must pass an oral candidacy exam that stresses material from their own research specialty and other related areas. Members of the student’s dissertation committee (usually selected at the beginning of the second year) comprise the exam committee. Ph.D. students must pass eight cumulative examinations that test the student’s critical awareness and understanding of the current literature.

Dissertation and Defense
The Ph.D. requires a dissertation based upon original research, either experimental or theoretical. For the Ph.D. candidate, a research project requiring three to four years of sustained effort will usually begin after the first year of study. An oral defense of the dissertation before a faculty committee completes the degree.
WILLIAM H. ARMSTRONG
Associate Professor
Ph.D., Stanford University, 1983
william.armstrong.1@bc.edu

RESEARCH INTERESTS
Transition metal complexes function as homogeneous catalysts in a wide variety of systems of biological and industrial importance. Professor Armstrong is involved in the development of catalytically active species placing emphasis on those that operate at the oxidizing and reducing extremes of the redox scale. He is particularly interested in multi-electron transformations. An example of a process under investigation that requires a highly oxidizing transition metal complex is the conversion of water to dioxygen, as carried out in photosynthetic organisms at a center that contains a cluster of four manganese atoms as well as one calcium atom. At the other extreme of the redox scale, Professor Armstrong seeks highly reducing species capable of reactions with small molecules such as N2, H2, CO and CO2. Nitrogenase is an enzyme that employs a MoFe7 metal cluster to catalyze the conversion of dinitrogen to ammonia. His approach to elucidation of the enzyme active site structures involves synthesis of novel transition metal clusters whose properties may be compared to those of the native system. An ideal biomimetic complex will not only reproduce the structural and spectroscopic properties of the enzyme, but will also be able to function as the enzyme does. After more is understood about the enzyme active site structure and function via this biomimetic approach, Professor Armstrong hopes to optimize the performance of artificial catalysts and to extend, or in some cases restrict, their substrate specificities.

RECENT PUBLICATIONS

JEFFERY A. BYERS
Associate Professor
Ph.D., California Institute of Technology, 2007
jeffery.byers@bc.edu

RESEARCH INTERESTS
A central theme to research in our laboratory is the investigation of novel or underdeveloped organotransition metal chemistry and its catalytic application to useful processes in the fields of organic chemistry, inorganic chemistry and materials science. One area of interest is in the development of iron-based complexes of catalytic cross-coupling reactions and exploring new or underutilized bond activation mechanisms for the rapid assembly of small molecules. We are also interested in developing practical “hybrid” catalysts used for the reversible hydrogenation of carbon dioxide to formic acid and/or methanol. This process would provide a means to store and transport hydrogen, a leading candidate to replace fossil fuels as a sustainable and renewable energy source. A final area of interest in our laboratory is the development of new synthetic techniques for the production of novel copolymers useful as traditional engineering polymers, biodegradable polymers or polymers useful for biomedical applications. To access these new materials, we have exploited transition metal catalysts that have tunable Lewis acidic properties as well as available one and two electron redox pathways.

RECENT PUBLICATIONS
RESEARCH INTERESTS

Biology is driven by molecular machines capable of highly sophisticated function. Our work takes an interdisciplinary approach to engineer such complex biological machines to create variants endowed with new useful functional capabilities—such as tools to tease apart complex biological riddles that are challenging to elucidate otherwise, and biologics to target human diseases that are challenging to cure with traditional therapeutics. In particular, we are developing powerful new tools to interrogate how post-translational modifications of human proteins shape human biology. We are also developing new ways to precisely probe and manipulate how viruses enter human cells. Our research combines elements from chemistry, biochemistry, molecular and cellular biology, and virology.

RECENT PUBLICATIONS


ABHISHEK CHATTERJEE
Assistant Professor
Ph.D., Cornell University, 2009
abhisek.chatterjee@bc.edu

RESEARCH INTERESTS

Atmospheric aerosol particles are produced by a variety of anthropogenic and biogenic sources. For example, incomplete fuel combustion produces aerosol particles containing black carbon. Trees as well as a range of industrial processes inject into the atmosphere organic gas phase species that are oxidized by radicals such as OH, O3 or NO3. The oxidized organics may then condense to form organic aerosol. Aerosol particles affect climate through direct and indirect interactions. Direct interactions consist of reflection or absorption by the particles of solar radiation. Indirect interactions are due to the role of hydrophilic aerosols in cloud formation and cloud lifetime. Clouds may either cool or warm the atmosphere depending on atmospheric conditions.

While the climate impact of the inorganic components of aerosol particles (e.g., sulfates, nitrates and mineral dust) is reasonably well understood, the climate effects of aerosol containing organic and refractory black carbon components are not well understood. For these species the parameters required to assess climate forcing are not adequately characterized. We have developed techniques for sampling, analyzing and measuring atmospherically relevant parameters including cloud-forming potential of aerosols. The Boston College group and our Aerodyne research partners perform laboratory as well as field studies measuring properties of atmospheric aerosol. In a recent field study we conducted pollutant emission measurements in New York and Mexico City. The data from our laboratory and field studies are used to model climate forcing and play a role in formulating pollution control measures.

RESEARCH INTERESTS

FACULTY PROFILES


JIANMIN GAO
Associate Professor
Ph.D., Stanford University, 2004
jianmin.gao.1@bc.edu

RESEARCH INTERESTS
The Gao group research centers on a critical cellular component: the membrane. Defining the boundary of a cell, the plasma membrane hosts close to a third of the entire proteome and mediates numerous signaling pathways. We take a multidisciplinary approach to interrogate the key molecular interactions that are critical for membrane function. Rational design and chemical synthesis of novel molecular tools is an indispensable part of our research. These synthetic tools allow one to inhibit protein-protein interaction in membranes and to target specific lipids pertinent to cell physiology and disease.

RECENT PUBLICATIONS

AMIR HOVEYDA
Patricia and Joseph T. ’49 Vandervsicle Millennium Professor and Chair of the Department
Ph.D., Yale University, 1986
amir.hoveyda@bc.edu

RESEARCH INTERESTS
Our research group is primarily concerned with the design and development of new selective transformations and their application to total synthesis of complex molecules of medicinal and/or biological significance. We are keen on the discovery of reactions that are enantioselective, which require inexpensive and non-toxic starting materials and which are catalytic. We are interested in developing processes that do not have precedence in classical organic chemistry. The addition of Grignard reagents to unactivated alkenes, different types of enantio- and/or Z-selective catalytic enantioselective olefin metathesis, catalytic enantioselective Strecrker amino acid synthesis, Cu-catalyzed conjugate additions, allylic substitutions and protyl-boron additions are only representative of the variety of new transformations that have recently been developed in our group.

Our interest in new reaction development is accompanied by a strong commitment to an understanding of mechanistic principles. It is through such knowledge that we hope to introduce new reagents and unusual modes of reactivity. However, we are aware that combinatorial chemistry and high-throughput screening is an exciting way to discover new catalytic processes. In fact, our group was one of the first to utilize such principles in developing efficient enantioselective reaction (Ti-catalyzed addition of TMSCN to epoxides). These exciting new strategies are routinely utilized in our research.

We appreciate that the true test of the utility of a new method is its usefulness in a total synthesis setting. Synthesis of complex natural products such as fluvirucin B, chloropeptin I, bacoipyrene C, claviolide C, epothilones A–D, nakadomarin A, neoptelotide, herbboxidiene and disoarzole C1 that are of biological significance is therefore a critical part of our research activities. Our synthesis schemes are strongly dependent on the success of protocols and pathways that have been conceived and developed in our own laboratories.

RECENT PUBLICATIONS
RESEARCH INTERESTS

Over the years, this research group has accomplished the total synthesis of approximately four dozen natural products. Individual natural products that we choose as targets range from structurally simple to complex. They are selected as objectives because their architectures are novel and have not been synthesized previously. Many also have important biological activities. Lactonamycin serves as a case in point, because it not only possesses an unprecedented structure but also because it has outstanding antibiotic activity against bacteria that are resistant to current antibiotics. Natural products whose synthesis we have completed of late include nigellicine, HKI 0231 and the antibiotics nostocine A and pseudoiodinine.

A second main area of research is the design and synthesis of what might be called molecular devices. The initial example was the first molecular brake. More recently, we reported the results of our studies on molecular “ratchets.” We have now also devised a related system that achieves unidirectional rotation. To wit, we have accomplished a prototype of a molecular motor by using the energy-rich chemical phosgene to power clockwise-only rotation in this molecule. Work is currently underway to optimize the system so that it rotates continuously and rivals the speed of its biological and mechanical counterparts.

Further areas of interest are molecular recognition and the process of self-assembly. Following the lead of biological systems that assemble spontaneously from their molecular components, we are seeking to develop sophisticated chemical systems that self-assemble from simpler pieces. Organic zeolites and other new materials are among the goals, with metal coordination and hydrogen bonding being the primary organizing forces.

In sum, we are pursuing a host of biological systems that assemble spontaneously from their molecular components, we are seeking to develop sophisticated chemical systems that self-assemble from simpler pieces. Organic zeolites and other new materials are among the goals, with metal coordination and hydrogen bonding being the primary organizing forces we hope to harness.

Note: This research laboratory is no longer accepting students or post-docs.

RECENT PUBLICATIONS

FACULTY PROFILES

**SHIH-YUAN LIU**

**Professor**

Ph.D., Massachusetts Institute of Technology, 2003

shihyuany.liu@bc.edu

**RESEARCH INTERESTS**

We are interested in the development of boron (B)-nitrogen (N)-containing heterocycles, specifically azaborines. These are structures resulting from the replacement of two carbon atoms in benzene with a boron and a nitrogen atom. Azaborines are isosteres of the important family of benzenoid compounds/arenes. They closely match the size and shape of ordinary benzene rings, and they still enjoy considerable aromatic stabilization, but most of their other physical, chemical and spectroscopic properties are significantly altered.

We aim to exploit the unique properties of azaborines and investigate their potential as arene surrogates in materials and biomedical research. Our approach combines the broad utility of arenes with the unique elemental features of boron. Areas of exploration include organic synthesis, catalysis and hydrogen storage, optoelectronic materials and drug discovery. The development of azaborines has the potential of changing the way chemists think about creating molecular diversity, namely through isosterism.

**RECENT PUBLICATIONS**


**DAVID L. MCFADDEN**

**Professor**

Ph.D., Massachusetts Institute of Technology, 1972

mcfadden@bc.edu

**RESEARCH INTERESTS**

My research involved kinetics and dynamics of free radical and electron attachment reactions in the gas phase. I remain active in teaching chemistry to undergraduate science majors, nursing students in the Lynch School of Nursing and a natural science core course, Intersection of Science and Painting.

**SELECTED PUBLICATIONS**


**LARRY W. MCLAUGHLIN**

**Professor**

Ph.D., University of Alberta, 1979

larry.mclaughlin@bc.edu

**RESEARCH INTERESTS**

Our primary research interests involve the understanding of the role(s) of weak interactions (ionic, hydrogen bonding and hydrophobic) in macromolecular complexes, primarily involving nucleic acids. These weak interactions often define three-dimensional structures that result in critical recognition events or in catalytic activity. To probe these interactions we employ organic chemistry to prepare analogue nucleosides or other non-nucleoside entities that are incorporated into DNA/RNA sequences. If the presence of the analogue interferes (or enhances) a critical interaction, then a corresponding effect is observed in assays of binding efficiency or catalytic effectiveness. By understanding these interactions in greater detail, our ability to then selectively interfere with the macromolecular processes of DNA replication, transcription or translational...
provides an important opportunity for targeting viral infection and cancerous growth. Using this approach we are studying DNA-protein and DNA-ligand interactions, the recognition of triphosphates by polymerases, the ability to target DNA duplexes (or single stranded sequences) using a third strand to form triplexes, and more recently the construction of nanoscale structures based on DNA “arms” and “junctions” formed from metal-ligand complexes. Our long-term goals are to better understand macromolecular interactions and to use that knowledge to develop new types of pharmaceuticals, particularly antivirals.

RECENT PUBLICATIONS


UDAYAN MOHANTY

Professor
Ph.D., Brown University
mohanty@bc.edu

RESEARCH INTERESTS

My research is in theoretical biophysics and physical chemistry. Our interdisciplinary research program utilizes and develops a range of novel and powerful techniques that spans fields from modern physical chemistry, biophysics, and soft condensed matter physics. The driving force in the advances of our research program is our close collaboration with experiment groups. A number of areas of current interest to us include (i) ion atmosphere around DNA, RNA, and riboswitch; (ii) stochastic process of rare events in biological systems.

RECENT PUBLICATIONS


JAMES P. MORKEN

Professor
Ph.D., Boston College, 1995
morken@bc.edu

RESEARCH INTERESTS

Synthetic organic chemistry has undergone a paradigm shift over the past 15 years with new metal-catalyzed transformations enabling bond formation in ways that chemists previously only dreamed about. Realizing the impact that new catalytic asymmetric reactions will have on the continued evolution of organic synthesis, we have focused our research on the development of new processes and on studying their utility in complex molecule synthesis. Our progress toward these goals depends upon expertise in many areas of chemistry including organometallic chemistry, physical organic chemistry and synthetic organic chemistry.

Reactions of particular interest to our group are those that involve stereoselective transformations of simple unsaturated organic substrates. Along these lines, our group has recently developed enantioselective diboration, conjunctive cross coupling and allyl-allyl coupling. These processes enable the simple, selective and efficient construction of versatile chiral reaction products. To evaluate the utility of these processes we have engaged in the total synthesis of complex natural products. These stereochemically and functionally complex structures provide a challenging proving ground for new methods and have also inspired new directions in the development of catalytic transformations.

RECENT PUBLICATIONS

JIA NIU
Assistant Professor
Ph.D., Harvard University, 2014
jia.niu@bc.edu

RESEARCH INTERESTS
The chemical landscape on the cell surface, including proteins, carbohydrates, lipids and other molecular species, have played crucial roles in regulating a variety of cell functions, including cell-cell interaction, cellular signaling, immune response and cell metabolism. Accordingly, engineering the chemical landscape of the cell surface with synthetic materials is increasingly regarded as a powerful approach for expanding the structural repertoire and properties of cells. Our lab will employ an interdisciplinary strategy that combines organic synthesis, polymer chemistry, bioconjugation, evolution and bioengineering approaches to establish new capabilities for the engineering of the chemical landscape of the living cell surface towards novel functions. In particular, we are interested in three research directions: First, we aim to develop novel carbohydrate-nucleic acid hybrid materials for highly specific binding to the cell surface lectins, leading to potential applications of engineering the signaling pathways mediated by the carbohydrate-lectin recognition. Second, we hope to design and synthesize a new class of glycomimetic synthetic polymers with unique molecular architectures and comonomer sequences for the engineering of the cell surface and modulating key cell functions. The third focus of our lab is to use light to spatially and temporally control cell adhesion for the fabrication of complex three-dimensional tissues in vitro.

RECENT PUBLICATIONS

MARC L. SNAPPER
Professor
Ph.D., Stanford University, 1991
marc.snapper@bc.edu

RESEARCH INTERESTS
The interrelated aspects of our research program include introducing new chemical transformations, building complex molecules with these new reactions, and using these compounds to study cellular function.

The development of new reactions continues to be an important endeavor in organic chemistry. Our efforts have been directed toward discovering better ways of constructing medium-ring-containing compounds. Using novel transformations that build molecular complexity rapidly have allowed for the efficient construction of seven- and eight-membered ring, containing natural products. Moreover, we have also investigated whether there are new ways to discover new reactions. In this regard, we have found that rational selection protocols using combinatorial techniques can provide very attractive catalytic solutions to longstanding chemical problems.

Employing new reactions in the total synthesis of challenging molecules is not only important for organic chemistry; it also allows us to contribute to biological chemistry. Building molecules with unique or unusual biological activities can offer powerful new tools for studying biological systems. For example, we have used the synthesis of ilimaquinone, a marine sponge metabolite, to uncover previously unknown functional aspects of the Golgi apparatus. Similarly, other natural products currently under study will be used to provide a better understanding of the biological systems they influence. Combining organic chemistry with select techniques in protein chemistry and molecular and cellular biology yields a powerful multidisciplinary approach for advancing our understanding of various important scientific issues.

RECENT PUBLICATIONS
- “New Cycloaddition/Fragmentation Strategies for Preparing 5-7-5 and 5-7-6 Fused Tricyclic Ring Systems.” He, J.; Snapper, M.L. Tetrahedron, 69, 7831-39, 2013.

CHIA-KUANG (FRANK) TSUNG
Associate Professor
Ph.D., University of California, Santa Barbara, 2007
frank.tsung@bc.edu

RESEARCH INTERESTS
Professor Tsung’s research program aims at establishing new synthetic strategies for the development of nano-catalysts to optimize energy-synthesis reactions and solar-to-chemical energy conversions. His program
includes nanomaterials synthesis and in-situ catalytic studies of solar-to-chemical energy conversions, syngas reactions, biomass reactions and low-temperature PEM fuel cell reactions. The main strategy is to precisely control the architecture and composition of the catalytic systems at the nanoscale in order to alter the nature of conventional materials, which are currently insufficient to solve the energy crisis. The program includes three directions. They are: (A) to design nanocomposite photocatalytic systems, (B) to develop high-surface-area photocatalyst film systems for visible-light driven water splitting, and (C) to create well-defined nanoparticle-based metal-metal oxide heterojunctions for catalysis studies.

RECENT PUBLICATIONS

MATTHIAS WAEGELE
Assistant Professor
Ph.D., University of Pennsylvania, 2011
waegle@bc.edu

RESEARCH INTERESTS
Our research team engages in spectroscopic investigation of catalytic interfaces that show potential for the synthesis of renewable fuels. The development of renewable fuel sources requires novel catalysts that efficiently and selectively enable the necessary chemical conversions. Our aim is to facilitate this development by elucidating the molecular events at the catalytic interface that lead from feedstock to fuel. In our research, we combine time-resolved spectroscopy with modern electrochemical methodologies.

An example of our principal research interests is the aqueous electrochemical reduction of carbon dioxide on copper electrodes. The electrified copper/electrolyte interface possesses the unique ability to reduce carbon dioxide to methane, a fuel, and ethylene, a valuable commodity chemical, under ambient conditions. A better understanding of which properties give rise to the uniqueness of this catalytic interface will facilitate engineering economically viable catalysts for these reactions. To this end, our research team addresses key questions in carbon dioxide reduction on copper electrodes, such as the mechanisms of C-O bond breaking and C-C bond formation.

RECENT PUBLICATIONS

DUNWEI WANG
Associate Professor
Ph.D., Stanford University, 2005
dunwei.wang@bc.edu

RESEARCH INTERESTS
The research in our lab bridges chemistry (in material synthesis), physics (property characterizations) and engineering (device constructions). We strive to meet the challenge of efficient solar energy conversion and utilization using novel nanoscale materials. Equipped with state-of-the-art facilities, we design, synthesize and study these materials. Our syntheses are guided by principles that have the potential to address usually correlated material aspects one at a time. We focus our attention on the surface and interface of nanoscale structures. Our understanding will lead to products suitable for solar cell and solar fuel applications.

RECENT PUBLICATIONS
**FACULTY PROFILES**

- **MasaYuki Wasa**  
  Assistant Professor  
  Ph.D., The Scripps Research Institute 2013  
  wasa@bc.edu

**RESEARCH INTERESTS**  
Our research program is centered on the development of polyfunctional Lewis pair catalysis for practical synthetic transformations with applications in drug discovery and development, and alternative energy. We will utilize these Lewis pair catalysts to enable reactions of inert substrates that cannot be activated efficiently by catalysts with a single activation center. Specifically, our initial efforts are focused on systematic identification of catalysts that will allow: a) transition metal-free asymmetric hydrogenation of various unsaturated substrates, b) reduction of CO2 to methanol, c) transition metal-catalyzed oxidative coupling of CO2 and olefins and d) late-stage regioselective functionalization of C–H bonds in biopotential molecules.

**RECENT PUBLICATIONS:**  

- **Eranthie Weerapana**  
  Associate Professor  
  Ph.D., Massachusetts Institute of Technology, 2006  
  eranthie@bc.edu

**RESEARCH INTERESTS**  
Cysteine residues play key functional roles in protein activity, including nucleophilic and redox catalysis, metal-binding and structural stabilization. Utilizing an interdisciplinary approach that merges synthetic chemistry, biochemistry, cell biology and protein mass spectrometry, our group seeks to interrogate the role of cysteine-mediated protein activities in physiology and disease. We are particularly interested in generating selective chemical probes to monitor these activities and characterize specific cysteine-containing proteins as viable therapeutic targets. Furthermore, we are applying chemical proteomic technologies to identify and characterize novel functional cysteine residues in the human proteome. We focus on applying these chemical and mass-spectrometric tools to investigate dysregulated cysteine-mediated protein activities implicated in cancer, aging and metabolic diseases and validate these proteins as potential therapeutic targets for these diseases.

**RECENT PUBLICATIONS:**  

- **X. Peter Zhang**  
  Professor  
  Ph.D., University of Pennsylvania, 1996  
  peter.zhang@bc.edu

**RESEARCH INTERESTS**  
Our research program has centered on the development of fundamentally new catalytic systems for stereoselective chemical transformations and their applications for practical synthesis of organic molecules.
of biomedical importance. We are particularly interested in developing one-electron catalytic approaches for homolytic radical chemistry to harness the vast potential of radical reactions for stereoselective construction of molecular structures. To this end, we have formulated “metalloradical catalysis” (MRC) as a concept to guide the development of general approaches for controlling reactivity and selectivity of various radical processes. For achieving enantioselective radical reactions, we have developed a family of unique chiral metalloradical catalysts based on structurally well-defined Co(II) complexes of D₂-symmetric chiral porphyrins with tunable electronic, steric, and chiral environments. These Co(II)-based metalloradical catalysts have shown to be highly effective for a wide range of stereoselective organic reactions. Due to their distinctive radical mechanisms that involve unprecedented metal-stabilized radical intermediates, such as α-metalloalkyl radicals and α-metalloaminyl radicals, the Co(II)-based metalloradical systems enable addressing some long-standing challenges in these important organic transformations.

Guided by the principles and hypothesis of metalloradical catalysis, we have successfully developed a number of fundamentally new and practically attractive catalytic systems for stereoselective construction of synthetically useful organic molecules via homolytic radical chemistry. Examples include the asymmetric processes for radical olefin cyclopropanation, radical olefin aziridination, radical C–H alkylation and radical C–H amination. Current ongoing research in the group is directed toward further exploration of new applications of metalloradical catalysis for solving other challenging organic transformations, including development of asymmetric catalytic systems for radical olefin epoxidation, radical C–H hydroxylation and various types of radical cyclization reactions. We aim to utilize these catalytic radical reactions in a cascade manner for stereoselective synthesis of complex molecules and natural products.

RECENT PUBLICATIONS

The oldest and largest of the University’s eight schools and colleges, the Morrissey College of Arts and Sciences offers graduate programs in the humanities, social sciences and natural sciences, leading to the degrees of Doctor of Philosophy, Master of Arts and Master of Science. In addition, numerous dual-degree options are offered in cooperation with the Carroll School of Management, the Boston College Law School, the Lynch School of Education and the Graduate School of Social Work.

With approximately 1,000 students and 400 full-time faculty, the Graduate School is small enough to know you as a person, but large enough to serve you and prepare you for a rewarding life and satisfying career.

Research Instrumentation and Facilities

The Department of Chemistry is housed in the 109,000 square-foot Eugene F. Merkert Chemistry Center, with modern classrooms, research laboratories, computation, instrumentation and facilities all in a single building. Continual improvements ensure that our resources are kept up-to-date. The Merkert Center’s sophisticated research facilities include a Mass Spectrometry facility that contains a wide range of state-of-the-art mass spectrometers and chromatographic systems; a high-field Nuclear Magnetic Resonance (NMR) facility, featuring two 400 MHz, two 500 MHz and a 600 MHz NMR spectrometers; and an X-ray crystallography facility. Our facilities are run by full-time professional scientific staff.

All faculty members participate in the design of individual laboratories, built to accommodate state-of-the-art instrumentation and to provide flexibility for changing research needs. For example, an X-ray crystallography laboratory is fully equipped with a diffractometer and area detector, constant temperature rooms for crystal growth and several VAX and silicon graphics computers for investigation of protein and small molecule structures. ESR spectroscopy, stopped-flow kinetics equipment, preparative centrifuges, scintillation counters, a DNA synthesizer, lasers and ultra-high vacuum apparatus are also available for use by individual research groups.

Other departmental instrumentation includes ReactIR, uV-Vis, atomic absorption, circular dichroism, GC- mass spectroscopy, gas and high performance liquid chromatography, magnetic susceptibility, electrochemistry, fermentation and DNA- and protein-sequencing equipment. Faculty research collaborations with several area institutions afford our graduate students and postdoctoral staff easy access to additional state-of-the-art instrumentation.

Boston College is deeply committed to advancing research instrumentation and facilities in accordance with its strategic plan for strengthening the physical and life sciences. For example, a state-of-the-art clean room is available. Significant new research instrumentation is planned for the Department of Chemistry in the areas of chemical biology, X-ray and advanced laser spectroscopy.

Academic Resources

GRADUATE RESEARCH SYMPOSIUM
Each October, the research activities of the Department of Chemistry are showcased during the Graduate Research Symposium. This event features seminar and poster presentations made by our graduate students. It is a highlight of the academic year, as it includes reports of the most exciting advances made in Department of Chemistry research groups during the preceding year.

GRADUATE STUDENT REPRESENTATIVES
Each year, several graduate students volunteer as department representatives and plan a variety of activities. In addition to planning the Graduate Research Symposium, they organize monthly “cume” breakfasts, movie nights and barbecues.

SEMINAR SERIES
The Department of Chemistry hosts a diverse seminar series that annually brings outstanding visiting scientists from around the world to campus for formal and informal interactions with all of the members of the department. Weekly seminars highlight nationally recognized speakers in organic, inorganic, physical and biological chemistry. In addition, the seminar series is highlighted by our annual university lectureship.
which invites acclaimed scientists to the department for a three-day visit that features stimulating daily seminars. Our recent university lecturers include: John Bercaw, California Institute of Technology; Ben Feringa, University of Groningen; Dennis Dougherty, California Institute of Technology; Charles Lieber, Harvard University; and Robert Bergman, University of California, Berkeley.

**Industrial Recruiting Program**

The Industrial Recruiting Program annually brings companies to the Merkert Chemistry Center to interview eligible students for post-degree job opportunities. This program is available to all undergraduate and graduate students in the chemistry and biochemistry majors at Boston College. Graduate students who are in their final year of study may participate during their search for permanent positions as well as undergraduates who are seeking summer internships or research associate positions. When industrial laboratories visit the Department of Chemistry, their recruiter/scientist typically gives a presentation, conducts individual interviews with students and meets with faculty. The recruiting schedule runs from September through December for Ph.D. candidates and January through March for B.S. candidates.

A few of the corporate partners who recruit at BC include, but are not limited to: Amgen, Merck, Novartis, ABBVIE, Biogen, Eisai and Bristol-Myers Squibb. For more information regarding this program, please contact the associate director for administration and graduate student services at 617-552-1735.

**OUTCOMES**

**Recent Placements**

The Department of Chemistry takes an active role in helping to place its students in attractive academic and non-academic positions. Our recent students’ placements have included:

**ACADEMIC PLACEMENTS**

- Boston University
- Brooklyn College
- Duke University
- Elon University
- Indiana University
- Kwangwoon University
- Massachusetts Institute of Technology
- Northeastern University
- Stanford University
- Texas A&M
- Tufts University
- University of Basel
- University of California, Berkeley
- University of Maryland
- University of North Carolina, Chapel Hill
- University of Notre Dame
- University of St. Thomas
- Whitehead Institute of Biomedical Research
- Washington College
- Wellesley College

**NON-ACADEMIC PLACEMENTS**

- Agilux Laboratories
- AstraZeneca Pharmaceuticals
- Biogen
- Blend Therapeutics
- Celgene
- Cubist Pharmaceutical
- Cytek Pharmaceuticals
- E-Link
- Eli Lilly
- Ensemble-Discovery Pharmaceuticals
- Exelixis
- Hamilton Brook Smith and Reynolds P.C.
- IBM
- Idenix Pharmaceuticals
- ImmunoGen Inc.
- Merck & Company
- Nano C, Inc.
- Novartis Institute of Biomedical Research
- Onyx Pharmaceuticals
- Pfizer Pharmaceuticals
- Samsung Cheil Industries
- Syros Pharmaceuticals
Boston College is located on the edge of one of the world’s most vibrant cities. Just six miles from downtown Boston—an exciting and dynamic place to live and learn—Boston College is an easy car or “T” ride away from a booming center for trade, finance, research and education.

Home to some of New England’s most prestigious cultural landmarks, including the Museum of Fine Arts, the Isabella Stewart Gardner Museum, Boston Symphony Hall and the Freedom Trail, Boston provides a rich environment for those passionate about art, music and history. For sports fans, Boston hosts a number of the country’s greatest sports teams: the Celtics, Patriots, Bruins and, of course, Fenway Park’s beloved Red Sox. Found within a short drive from Boston are some of New England’s best recreational sites, from the excellent skiing in New Hampshire to the pristine beaches of Cape Cod.

Boston also offers a wide range of family friendly attractions, including the Children’s Museum, New England Aquarium, Franklin Park Zoo and the Museum of Science. There are roughly 50 universities located in the Boston area, and the large student population adds to the city’s intellectually rich and diverse community. Events, lectures and reading groups hosted by world-renowned scholars abound on area campuses, providing abundant opportunities to meet and network with other graduate students and faculty throughout the Boston area.

The University

Boston College is a Jesuit university with 14,250 students, 805 full-time faculty and more than 175,000 active alumni. Since its founding in 1863, the University has known extraordinary growth and change. From its beginnings as a small Jesuit college intended to provide higher education for Boston’s largely immigrant Catholic population, Boston College has grown into a national institution of higher learning that is consistently ranked among the top universities in the nation: Boston College is ranked 31st among national universities by U.S. News & World Report.

Today, Boston College attracts scholars from all 50 states and over 80 countries, and confers more than 4,000 degrees annually in more than 50 fields through its eight schools and colleges. Its faculty members are committed to both teaching and research and have set new marks for research grants in each of the last 10 years. The University is committed to academic excellence. As part of its most recent strategic plan, Boston College is in the process of adding 100 new faculty positions, expanding faculty and graduate research, increasing student financial aid and widening opportunities in key undergraduate and graduate programs.

The University is comprised of the following colleges and schools: Morrissey College of Arts and Sciences, Carroll School of Management, Connell School of Nursing, Lynch School of Education, Woods College of Advancing Studies, Boston College Law School, Graduate School of Social Work and School of Theology and Ministry.

General Resources

HOUSING

While on-campus housing is not available for graduate students, most choose to live in nearby apartments. The Office of Residential Life maintains an extensive database with available rental listings, roommates and helpful local real estate agents. The best time to look for fall semester housing is June through the end of August. For spring semester housing, the best time to look is late November through the beginning of the second semester. Additionally, some graduate students may live on campus as resident assistants. Interested students should contact the Office of Residential Life.
JOHN COURTNEY MURRAY, S.J., GRADUATE STUDENT CENTER
One of only a handful of graduate student centers around the country, the Murray Graduate Student Center is dedicated to the support and enrichment of graduate student life at Boston College. Its primary purpose is to build a sense of community among the entire graduate student population and cultivate a sense of belonging to the University as a whole. Its amenities include study rooms, a computer lab, two smart televisions, kitchen, deck and patio space, complimentary coffee and tea, and more. Throughout the year, the center hosts programs organized by the Office of Graduate Student Life and graduate student groups. The Murray Graduate Student Center also maintains an active job board (available electronically), listing academic and non-academic opportunities for employment both on and off campus.

MCMULLEN MUSEUM OF ART
Serving as a dynamic educational resource for the national and international community, the McMullen Museum of Art showcases interdisciplinary exhibitions that ask innovative questions and break new ground in the display and scholarship of the works on view. The McMullen regularly offers exhibition-related programs, including musical and theatrical performances, films, gallery talks, symposia, lectures, readings and receptions that draw students, faculty, alumni and friends together for stimulating dialogue. Located on the main campus, the McMullen Museum is free to all visitors.

CONNORS FAMILY LEARNING CENTER
Working closely with the Graduate School, the Connors Family Learning Center sponsors seminars, workshops and discussions for graduate teaching assistants and teaching fellows on strategies for improving teaching effectiveness and student learning. Each fall, the Learning Center and the Graduate School hold a “Fall Teaching Orientation” workshop designed to help students prepare for teaching. The center also hosts ongoing seminars on college teaching, higher learning and academic life; assists graduate students in developing teaching portfolios; and provides class visits and teaching consultations, upon request. Through these and other activities, the Connors Family Learning Center plays an important role in enhancing the quality of academic life at Boston College.

FLYNN RECREATION COMPLEX
The 144,000-square-foot Flynn Recreation Complex houses a running track; tennis, basketball, volleyball, squash and racquetball courts; an aquatics center with pool and dive well; saunas and more. Its 10,000-square-foot Fitness Center offers more than 100 pieces of cardio equipment, a full complement of strength training equipment and free weights, an air-conditioned spin studio and three air-conditioned group fitness studios. During the academic year, BC Rec holds more than 80 group fitness classes per week in a variety of disciplines, including Zumba, spin, yoga, strength training, Pilates and more.

BOSTON COLLEGE CAREER CENTER
The Boston College Career Center works with graduate students at each step of their career development. Services include self-assessment, career counseling, various career development workshops, resume and cover letter critiques, and practice interviews. In addition to extensive workshop offerings, Career Center staff members are available throughout the year for one-on-one advising about any aspect of the career path. The Career Resource Library offers a wealth of resources, including books, periodicals and online databases.
Student Profiles

Our graduate students come from across the United States and the globe. The program’s demographics vary: currently it is 55 percent male, 45 percent female and includes 45 percent international students. While some students enroll in the Ph.D. program immediately following their undergraduate studies, others begin their studies after working in a chemistry-related industry.

Admission Requirements

The application deadline for fall admission is January 2. Please visit bc.edu/gsas for detailed information on how to apply.

Application requirements include:

- **Application Form:** Submitted online, via the GSAS website.
- **Application Fee:** $75, non-refundable.
- **Abstract of Courses Form:** A concise overview of background and related courses completed in an intended field or proposed area of study.
- **Official Transcripts:** Demonstrating coursework completed/degree conferral from all post-secondary institutions attended. Documents should show required courses: those normally required for a B.S. degree in chemistry, biochemistry or chemical biology.
- **GRE General Test:** Official score report required for all applicants.
- **GRE Subject Test:** Official score report required for graduates of foreign universities and recommended for all applicants.
- **Three Letters of Recommendation:** From professors or supervisors.
- **Statement of Purpose:** A brief (one-two page) discussion of area(s) of research interest (organic, bioorganic, chemical biology, inorganic, theoretical, computational, physical and biophysical). Additionally, identify specific research faculty who are of interest as future advisors.
- **Proof of English Proficiency:** Official TOEFL/IELTS score reports accepted.

Financial Assistance

**DEPARTMENT FUNDING**

First-year graduate students typically receive financial support as teaching assistants during the academic year, serving as instructors in undergraduate laboratories or as leaders of classroom discussion sections. For lab TAs, responsibilities include six to eight hours of weekly contact time in lab with students as well as grading lab reports. Discussion TAs attend class lectures, oversee four, one-hour discussion periods per week and assist in grading quizzes and exams. All TAs hold office hours for their students. Teaching assistantships carry a nine-month stipend. Tuition-remission scholarships are also awarded to graduate students to cover the cost of program requirements.

Financial support during the summer is available to students as either research or teaching assistantships. Research assistantships are provided by individual professors from existing research grants, while teaching assistants are supported from departmental funds. Summer stipends cover three months’ salary. The average yearly stipend for 2016–2017 was $30,000.

**FEDERAL FINANCIAL AID**

Graduate students can apply for federal financial aid using the FAFSA. The loans that may be available to graduate students are the Federal Direct Unsubsidized Stafford Loan and Perkins Loan, based on eligibility. If additional funds are needed, student may apply for a Grad Plus Loan. For more information, see the Graduate Financial Aid website at bc.edu/gradaid or contact the Graduate Financial Aid Office at 617-552-3300 or 800-294-0294.

**OFFICE OF SPONSORED PROGRAMS**

The Office of Sponsored Programs (OSP) assists both faculty and graduate students in finding sources of external funding for their projects and provides advice in the development of proposals. OSP maintains a reference library of publications from both the public and private sectors listing funding sources for sponsored projects. In the recent past, graduate students have received research support from prominent agencies, corporations and organizations such as the Fulbright Commission, the Guggenheim Foundation, the National Science Foundation, the American Political Science Association, the American Chemical Society and the American Association of University Women.