Chemistry and Biochemistry at Georgia Tech

J. Cameron Tyson, Ph.D.
Senior Academic Professional, Graduate Coordinator
Brief History

University founded in 1885 in Atlanta, GA
Department established in 1902
First PhD Awarded in 1952
Largest Department in GT College of Sciences

Community

41 Faculty
40 Post Doctoral Fellows and Staff
220 Graduate Students, 275 Undergraduate Students

Degree Programs

Ph.D. in Chemistry
B.S. in Chemistry
Masters in Chemistry
B.S. in Biochemistry
Campus & Department Profile

GT Campus: 13,000 Undergraduates + 6500 Graduate Students

Chemistry and Biochemistry:

Undergraduates:
47% Women, 95% US citizen/permanent resident, 25% underrepresented (African-American, Hispanic, Native-American, Asian-American)

Graduate Students:
95% PhD seeking, 43% Women, 70% US citizen/permanent resident, 15% underrepresented (African-American, Hispanic, Native-American, Asian-American); 27% international
CHEMISTRY AND BIOCHEMISTRY BUILDINGS

- Institute of Bioscience and Bioengineering
- Ford Environmental Science and Technology Building
- Molecular Science and Engineering Building
- Institute of Paper Science and Technology
- Boggs Chemistry Building
Centers and Research Facilities

Laser Spectroscopy (Laser Dynamics Lab)
NMR Spectroscopy Center (Six 300-500 MHz NMRs)
Center for Computational Molecular Science and Technology
Center for Organic Photonics and Electronics (COPE)
Center for Biomaterials Education and Research
Center for Chemical Biology (Origins of Life Project)
Research Sponsors of the School of Chemistry and Biochemistry

Approximately $16 million per year of external funds in support of research.

Federal Government
National Science Foundation
Chemistry Division
Biology Division
Division of Materials Research
Division of Undergraduate Education
National Institutes of Health
National Cancer Institute
National Institute of Drug Abuse
National Eye Institute
National Institute for General Medicine
Department of Defense
U.S. Army
U.S. Air Force
U.S. Navy
DARPA
Environmental Protection Agency
Department of Commerce
National Textile Center
National Aeronautics and Space Administration (NASA)
Department of Agriculture
Department of Energy
Department of Education

Industry
Albemarle
Ball Aerospace
BASF Biotechnology
Battelle
Chevron
Colonial Pipeline
Degussa
DuPont
Delta Airlines
Hercules Chemical
Hewlett-Packard
Huntsman
KoSa
Olin Chemicals
Pfizer Inc.
Solvay
Texaco
3M Company

Private Foundations
American Chemical Society
Lilly Foundation
American Cancer Society
Beckman Foundation
Sloan Foundation
Research Corporation
Dreyfus Foundation
American Heart Association
Southeastern University Alliance
Howard Hughes Medical Institute
RESEARCH THRUST AREAS

Advanced Materials
Computational Chemistry
Biomolecular Structure/Biophysics
Photochemistry
Surface Chemistry
Nanochemistry
Medicinal Chemistry
Environmental Chemistry
Biorenewable energy
Paper
## STRATEGIC PLANNING: RESEARCH

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<td>Advanced Materials</td>
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<tr>
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<td>Paper Science Chemistry</td>
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Polyphilic Fluoroalkyl conjugated polymers
Poly(paraphenylene ethynylene)s PPE and related polymers
Polymers for Microelectronics and Photovoltaics
Polymer Bonding Materials for Low cost Chip Packing
Biogenic and Bioresponsive Conjugated Polymers
Threaded and Cyclic Macromolecules
Bubble Array Formation of Conjugated Polymers
Fundamentals of Colloidal Assembly
NMR Studies of Fluids in Porous Media
Nano-biocomposites
SYNTHETIC AND MECHANISTIC ORGANIC CHEMISTRY

Professors L.M. Tolbert, G.B. Schuster, C.L. Liotta, S. Marder, D.M. Collard, C.J. Fahrni, A. Ragauskas, W. Kelly, S. France

Bioorganic chemistry of Polyketide and Nonribosomal Peptide Antibiotics
Design of Novel DNA-intercalating Topoisomerase Inhibitors as Antitumor and Anti-infective Agents
Bio-organometallic Catalysts
Arene-Arene Interactions
Chemical Ecology and Chemical Communication
DNA-Photochemistry Charge Transport
Two-Photo Chemistry
Alkynylated Heterocycles
Photoacids, Photobiology, and Photopolymerization
Long-range Energy Transfer in Biomaterials
Organic Electronics
Synthesis of Complex Natural and Unnatural Targets
Bioinspired Designs for Small-Molecule Activation
New Materials with Negative Thermal Expansion
Fluorescence Probes for Intracellular Storage, Trafficking, and Homeostasis of Trace Elements
Magnetic Nanoparticles
Immobilized Single-Site Organometallic Catalysts
Application of Synchrotron X-ray methods
Thermoelectrics
Bio-enabled Syntheses of Functional Inorganic Materials
SENSORS, ENVIRONMENTAL, AND ANALYTICAL CHEMISTRY

Professors J.A. Janata, L.A. Bottomley, T. Orlando, L.A. Lyon, F. Fernandez

Bioanalysis of Bioresponsive Materials
Mass Spectrometry and Proteomics
Design of Materials for CHEMFETs
Microcantileve Array-based Biosensors
Label-free Electrochemical DNA Hybridization Arrays
Magnetic Quartz Crystal Microbalance
Laser Based Methods for Mass Spectrometry
PHYSICAL CHEMISTRY: SINGLE MOLECULES, SURFACES, NANOPARTICLES, AND MOLECULAR BIOPHYSICS


Fluorescence Imaging of Cellular Reaction Dynamics
Shape-dependent Nanocatalysis
Synthesis and Characterization of Nanocrystals and Arrays
Single-molecule Orientational Microscopy
Nonlinear Optical Properties of Organic Photonic Arrays
Electron Transfer in Enzymes
Cold Molecular Ions
Femtosecond Laser Dynamics in Semiconductor Nanoparticles
Low Energy Electron Collisions with Complex Targets
Oxide Surface Chemistry
Two-photon 3D Fluorescence Imaging of Biomolecular Interactions
Nonthermal Processes at Biological Interfaces
LASER DYNAMICS LABORATORY

Techniques
- Transient Optical Absorption Spectroscopy
- Time-resolved Raman and FT Raman spectroscopy
- Time-resolved IR and FTIR spectroscopy
- Fluorescence
- Time-correlated single photon counting
COMPUTATIONAL AND THEORETICAL CHEMISTRY

Professors R. Hernandez, C.D Sherrill, J-L Bredas, K. Brown
(+ collaborations with M.A. El-Sayed, and C.J. Fahrni)

Quantum Simulations of Molecules and Materials
Bond-breaking Reactions, Diradicals, and Non-dynamical Correlation
Electronic Structure of Organic Semiconductors
Far-from-Equilibrium Chemistry: Swelling and Driven Colloids
Nonlinear Optical Properties of Pi-Conjugated Chromophores
Far-from-Equilibrium Chemistry: Controlling Diffusion on Surfaces
Modeling Photophysics and Photochemistry in Biological Systems
Fundamental Forces of Molecular Recognition
Understanding and Controlling Nucleic Acid Assembly
Post-translational Modifications in Membrane Proteins
Oligonucleotide Small Molecule Interactions
Protein Misfolding and Mistrafficking
Intramembrane proteolysis
Structural Elucidation of Nucleic Acid and Protease Complexes
Engineering Nuclear Hormone Receptors
BIOCHEMISTRY, BIOMOLECULAR STRUCTURE, AND BIOPHYSICS contd.

Neuropeptide Processing and Molecular Neurochemistry
Computational Structural Biology
Oxygen Production in Plant Photosynthesis
Molecular Basis of Selenium’s Role in Human Health and Disease
Organized Nucleic Acids
Biosynthetic Engineering
Biomineralization
Protein Folding and Ligand Binding
NANOCHEMISTRY

Professors M. El-Sayed, R. Dickson, T. Orlando, J. Perry, A. Ragauskas, A. Lyon, Z.L. Wang, L. Bottomley, ZJ Zhang

New Properties of Noble Metal Nanoparticles
Optical Properties of Individual Nanoparticles
Nanopatterning and Enhanced Film Growth Using Low-energy Electrons
Multi-Photon 3D Micro and Nanofabrication
Nano-Biocomposites
Designed Bio-infaces
Gold Nanoparticles in Nanomedicine
Controlled Growth of Oxide Nanostuctures
Targeted Drug Delivery
Nanomechanics of Nucleic Acids and Proteins
Piezoelectric Nanogenerators
Nanomechanics of Carbon Nanotubes, Nanosprings, and Nanocoils
Biomedical applications of Magnetic Nanoparticles
ENVIRONMENTAL CHEMISTRY AND SUSTAINABLE TECHNOLOGIES


Atmospheric Chemical Kinetics and Photochemistry
Organic Chemistry Using Phase Transfer Catalysis/Green Chemistry
Photoinduced Multielectron Chemistry for Solar Fuels Production
Energy and Fuels for Renewable Resources
Planetary and Environmental Surface Science
Novel Synthesis of Biofuels and Biochemicals
Biotechnological Approaches for Production of New Materials
Biocatalysis
EQUIPMENT AND FACILITIES

Nuclear Magnetic Resonance
300, 400, 500 MHz solution; 300, 400 MHz solid state; variable temperature, multidimensional, multinuclear

Biochemistry
Protein synthesis, protein expression, DNA synthesis

Material Analysis
Differential scanning calorimetry, thermal gravimetric analysis, instron, rheology

Crystallography

Microscopies
Light, infrared, scanning tunneling, atomic force, scanning electrochemical, scanning electron, tunneling electron

Spectroscopies
Electron spin resonance, infrared, Raman, Mossbauer ....

Chromatography
High pressure liquid, ion, gel permeation, gas, ....

Fast Kinetics Mass Spectrometry
EI, CI, FA, MALDI-TOF

Other
Electrochemistry, circular dichroism, High Vacuum Surface Science Chambers

Computational
72-processor IBM SP2 supercomputer, two IBM 270 SMP Workstations, SGI 4-way O2000 single user workstations
# Faculty and Research Workforce

<table>
<thead>
<tr>
<th>Faculty Name</th>
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<tbody>
<tr>
<td>E. K. Barefield</td>
<td>R. Hernandez</td>
<td>J. C. Powers</td>
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<tr>
<td>B. Barry</td>
<td>P. Houston</td>
<td>A. Ragauskas</td>
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<tr>
<td>H.W. Beckham</td>
<td>N. Hud</td>
<td>G.B. Schuster</td>
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<td>A. Bommarius</td>
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<td>L.A. Bottomley</td>
<td>W. Kelly</td>
<td>J. Soper</td>
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<td>J.L. Bredas</td>
<td>N. Kroger</td>
<td>M. Srinivasarao</td>
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<td>K. Brown</td>
<td>J. Kubanek</td>
<td>L.M. Tolbert</td>
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<td>R. Lieberman</td>
<td>Z.L. Wong</td>
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<td>D.M. Collard</td>
<td>C.L. Liotta</td>
<td>M. Weck</td>
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<td>R.M. Dickson</td>
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<td>R.L. Whetten</td>
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<tr>
<td>D. Doyle</td>
<td>S. Marder</td>
<td>A.P. Wilkinson</td>
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<tr>
<td>C.A. Eckert</td>
<td>S.W. May</td>
<td>L.D. Williams</td>
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<td>M.A. El-Sayed</td>
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<td>P.H. Wine</td>
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<tr>
<td>C.J. Fahrni</td>
<td>Y. Oyelere</td>
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<td>F. Fernandez</td>
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<td>S. France</td>
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+ 200 Graduate Students, Post-docs, Research Scientists, and Staff
Georgia Tech Career Opportunities

Career Fair each semester

Recent Employers: U.S. Centers for Disease Control and Prevention (CDC), Celanese, Georgia Pacific, Motorola, DuPont, Coca-Cola, Merck, Michelin, 3M, Texaco, Proctor and Gamble, Milliken, Intel, NASA, Dow-Corning, Ciba Vision + several graduates placed in academic positions
PhD Fellowship and Research Opportunities

Assistantship Stipend and benefits beginning Fall 2010

- $22,100 per annum
- Waiver of tuition
- Health benefits

Free Application: www.chemistry.gatech.edu (graduate button) or grad.info@chemistry.gatech.edu
Campus Life and Atlanta!!!
GO TECH and Thank you!!!!