Breaking Barriers in Diversity and Innovation

Chemical Engineering + Biomedical Engineering Academic Programs

The unique model of the nation's only joint college of engineering affords our department a wonderful opportunity to combine cutting-edge research with shaping the next generation of engineers from across the demographic spectrum.

We've taken this nexus and invested heavily in partnerships and resources that offer an unequaled opportunity for graduate and undergraduate students at both Florida A&M University and Florida State University to delve into complex and exciting research in some of the most innovative labs available. From the National High Magnetic Field Laboratory to the FSU College of Medicine and FAMU College of Pharmacy & Pharmaceutical Sciences, our research takes place in collaborative, multidisciplinary work.

Active Research Collaborations

- Florida State University Institute of Molecular Biophysics (IMB)
- FSU Department of Scientific Computing
- National High Magnetic Field Laboratory (NHMFL)
- FSU Biomedical Research Facility - Laboratory Animal Resources (BRF-LAR)
- FSU & FAMU Departments of Chemistry, Physics and Biological Sciences
- FAMU Department of Pharmacy and Pharmaceutical Sciences
- FAMU-FSU College of Engineering's Mechanical, Electrical & Computer, and Industrial & Manufacturing engineering departments

Degree Programs

B.S. Biomedical Engineering
- *Cell & Bioprocess Engineering*
- *Biomaterials & Biopolymers Engineering*
- *Image & Signal Process Engineering*

B.S. Chemical Engineering
- *Chemical Engineering*
- *Chemical-Materials Engineering*

Bachelor of Science and Master of Science (B.S.-M.S.) pathway

M.S. (non-thesis) Biomedical Engineering
M.S. (non-thesis) Chemical Engineering
M.S. Biomedical Engineering
M.S. Chemical Engineering
Ph.D. Biomedical Engineering
Ph.D. Chemical Engineering

Most Recent Faculty Awards

Jamel Ali
National Academy of Engineering (NAE) Grainger Foundation Award (2022)

Jamel Ali
United States Air Force (USAF) Young Investigator Award (2022)

Rufina Alamo
American Association for the Advancement of Science (AAAS) Fellow (2023)

Theo Siegrist
Academy of Science, Engineering and Medicine of Florida (ASEM-FL) Fellow (2023)

Subramanian Ramakrishnan
AIChE Distinguished Service Award (2023)

Yan Li
Executive Leadership in Academic Technology, Engineering & Science (ELATES) Fellow (2023)

Ayyalusamy (Rams) Ramamoorthy
International Society for Magnetic Resonance (ISMAR) Fellow (2023)

Yan Li
American Institute for Medical and Biological Engineering (AIMBE) Fellow (2024)

Bruce R. Locke
National Academy of Inventors (NAI) Fellow (2024)

Raim Ricarte 3M Non-Tenure Award (2024)

Other Society Fellows

Bruce R. Locke
American Institute for Chemical Engineering (AIChE)

Rufina Alamo
American Physical Society (APS)

Theo Siegrist
American Physical Society (APS)

Ayyalusamy (Rams) Ramamoorthy
Michigan Society & Royal Society of Chemistry

National Science Foundation (NSF) CAREER Awards

Natalie Arnett
Daniel Hallinan, Jr.
Yan Li
Hadi Mohammadigoushki
Raim Ricarte

FAMU-FSU College of Engineering

2525 Pottsdamer Street
Tallahassee, FL 32310
www.eng.famu.fsu.edu

One **college**,
two **universities**,
unlimited **opportunity**.

The FAMU-FSU College of Engineering is the joint engineering institution for Florida A&M and Florida State universities, the only such shared college in the nation. We are located less than three miles from each campus. After satisfying prerequisites at their home university, students learn together at the central engineering campus with its adjacent, associated research centers and a national laboratory.

FAMU-FSU College of Engineering

DEPARTMENT OF **CHEMICAL & BIOMEDICAL** ENGINEERING

Department of Chemical & Biomedical Engineering

Annual Report 2024

Innovating technological advances while educating the next generation of engineers

Fall 2024

A Message from

Bruce R. Locke, Ph.D.
Chair, Department of Chemical & Biomedical Engineering

On behalf of the faculty, staff and students of the Department of Chemical and Biomedical Engineering at the FAMU-FSU College of Engineering, I am pleased to introduce this Annual Report to you. We have an outstanding group of faculty members who are leading research efforts on topics of importance to human health, technology development and the environment. For example, research in biomedical engineering addresses critical areas of metabolic disease and neurological diseases and the development of biological therapeutics such as monoclonal antibiotics and stem cell-based therapies. Faculty are also developing new biologically based polymers to help alleviate the worldwide issue of plastic pollution and the development of renewable materials, and other research is addressing the recovery of rare earth elements from mining waste. Please read about our faculty members' other research topics and note the impressive and record number of external awards and new grants they have earned. We are grateful for the support from the many funding agencies, including NIH, NSF, NASA, US Army, USAFORR, and the State of Florida.

Our students continue to excel and I would like to highlight the strong participation of our undergraduate students in faculty research. The department Honors-in-the-Major program had 12 students defend their honor theses in 2024 with another 15 in progress for 2025. These honors students go on to graduate school and industry positions and have received significant awards such as the NSF Graduate Research Fellowship. This program is possible because of the vital participation of the graduate students and postdocs who work alongside our faculty members to mentor these students.

The quality and number of our students, faculty, postdocs and staff are at the highest levels in our program's history. I expect the department to continue to develop through hiring additional faculty members and recruiting top students. We hope you will consider joining us to help solve some of the world's most pressing challenges and to follow our exciting trajectory.

The Joint College by the Numbers

#60
Public Engineering College with Doctorate
(U.S. News & World Report 2024)

3K+ Total Students

144 Faculty Members

Department by the Numbers (Fall '24)

586 Undergraduate Students

73 Graduate Students

800+ Alumni

Rankings (U.S. News & World Report 2024)

#65 Biomedical Program Ranking

#52 Chemical Program Ranking

Enrollment

50% Female Students in CBE

75% URM Students in CBE

24% Increase in CBE Graduate Enrollment Over Past 5 years

87% Growth in Graduate Student Enrollment Since 2014

Research

24 Number of Patents Held by CBE Faculty

11 Patents Licensed to Companies in Last 5 Years

$334K Grants and Awards Per CBE Faculty Member

$324K Research Expenditure Per CBE Faculty Member

155% Increase in Research Expenditures Over Past 5 Years

106% Increase in Grants and Awards Over Past 5 Years

$21M In Active Awards as of August 2024

Chemical & Biomedical Research Laboratories at the Joint College

Complex Fluids and Nanomaterials Research Group

Led by **Subramanian Ramakrishnan,** the laboratory focuses on understanding the physics and chemistry of complex fluids (colloids, proteins, polymers and other "soft materials") with an aim of producing useful materials for engineering applications, such as biomass to energy conversion, biological separations and regenerative medicine.

Polymers for Advanced Energy Sustainability Lab

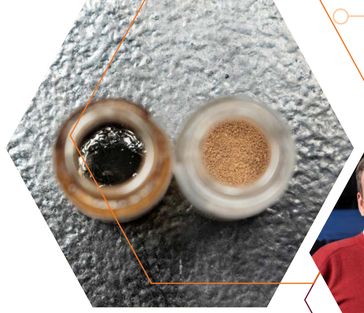
A research group led by **Daniel Hallinan, Jr.** studies the dynamics of heterogeneous polymer materials, such as block copolymers and polymer-grafted nanoparticles. Multiple phases dispersed throughout a material enables advanced properties that cannot be achieved in materials without structure. For example, they can combine a hydrophilic phase that conducts water or ions with a hydrophobic material that provides mechanical strength. The effect of structure on water and ion transport as well as mechanical strength can be complex. Therefore, the team pursues advanced experimental techniques that allow them to measure multicomponent diffusion and local relaxations.

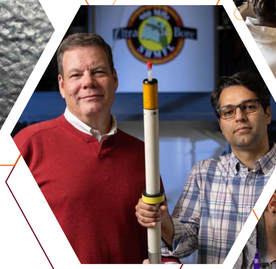
The Ricarte Lab for Polymer Science and Engineering Research

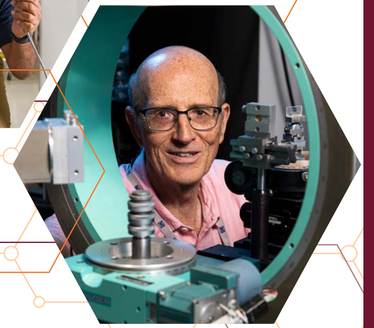
The group led by **Ralm Ricarte** investigates how enhanced chemical functionality affects fundamental, but technologically important, physical properties of novel polymer materials for energy storage, separations, medicine, consumer products and advanced performance materials. The lab uses scalable polymer synthesis techniques to create materials with intricate functionality via cryogenic and analytical electron microscopy, scattering (soft and hard X-rays, neutrons, light, and electrons), rheology and theoretical modeling.

Micro Wonders with Maximum Impact

Jamel Ali leads the Nanobio Materials and Robotics Group in the National High Magnetic Field Lab, which is closely associated with the joint college. The group designs small-scale biologically-inspired machines, or nanorobots, that can be wirelessly controlled and harness the actuation capabilities of microorganisms.







POLYMERS

Using CO2 and Biomass, Engineering Researchers Find Path to More Environmentally Friendly Recyclable Plastics

Ho Yong Chung and a team of researchers have created a potential alternative to traditional petroleum-based plastic made from carbon dioxide (CO2) and lignin, a component of wood that is a low-cost byproduct of paper manufacturing and biofuel production. This study is the first to demonstrate the direct synthesis of what's known as a cyclic carbonate monomer—a molecule made of carbon and oxygen atoms that can be linked with other molecules—made from these components.

HORMONES

Researchers Examine Role of Crucial Hormone and Exercise

Tristan Driscoll and other researchers examined the role adiponectin plays in the circulatory system of aging adults and how exercise affects its influence on vascular health. Driscoll measured the mechanical forces produced by vascular cells and how their stiffness changes in response to changes in adiponectin and exercise. The research aims to offer more insight into how exercise brings benefits and explore how adiponectin can be used for treatment.

ARTIFICIAL INTELLIGENCE

Unleashing the Power of AI to Solve Important Microscale Challenges

Researchers led by **Leo Liu** are advancing the power of high-performance computing powered by artificial intelligence (AI) to combat blood disorders like thrombosis, which causes heart attacks and strokes. Liu's group investigates flow-mediated solidification, a phenomenon related to biological processes like blood clotting. Using supercomputing powered with AI, the team develops multiphysics and multiscale modeling tools to understand what's happening.

BIOLOGIC THERAPEUTICS

Safer Processing for Therapeutics Targeting Infectious Diseases, Autoimmune Disorders and Cancer

New research reveals problems that can affect biologic therapeutic product quality and shelf life. The problem, the researchers say, is how monoclonal antibodies are structured. They adsorb air and oil, and this adsorption interferes with the molecule's structure, affecting the quality, safety, shelf life and efficiency of the product. If successful, the research led by **Hadi Mohammadigoushki** will advance our fundamental knowledge of monoclonal antibodies and their interactions with fluid-fluid interfaces and help mitigate risks in developing these therapeutics.

METABOLIC DISEASE

Zinc and pH Modulate the Ability of Insulin to Inhibit Aggregation of Islet Amyloid Polypeptide

Rams Ramamoorthy. Aggregation and toxicity of a human hormone, amylin, are linked to the pathology of type-2 diabetes. In a recent study, **Rams Ramamoorthy's** team reported the ability of insulin to inhibit amylin's aggregation and toxicity.

MATERIALS

Tin Selenide May Hold the Key for Thermoelectric Solutions

Theo Siegrist and his research team discovered that atomic-level structural changes occur when the compound tin selenide heats up—changes that help it to conduct electricity but not heat. A good thermoelectric material needs strong electrical conductivity but thermal conductivity that is as low as possible. In tin selenide, this is achieved by a dynamic partial disorder of the tin atoms at elevated temperatures that results in a reduction of the heat conductivity. The study provides information that could lead to new technologies for applications such as refrigeration or waste heat recovery from cars or nuclear power plants.

Dive deeper: *famufsu.engineer/cbe*

Yan Li

Professor of Chemical & Biomedical Engineering

"My research enables human stem cell-based therapeutics and brain tissue models for drug screening by regulating cell-matrix and cell-cell signaling, which can lead to the therapeutic targets for treating ischemic stroke, Alzheimer's disease, brain tumors and more."

Read more about her work: