



# Chemistry

## COMPETENCIES AND RESEARCH

The mission of the chemistry department at Tufts, according to the chair, Krishna Kumar, is to maintain its standing as a very high-quality research department while at the same time maintaining its commitment to training. “We take teaching very seriously and have made a lot of innovations there as well,” said Kumar. Looking to the future, the department is focused on strengthening its faculty at the interface between chemistry and biology. “That could mean therapeutics, basic biomedical research, and everything else that falls under that umbrella,” said Kumar. The other two priority areas for growth are in energy-related research and materials research. The good news is that even in the currently dire economy, the department was able to bring on two new faculty members recently. “This is going to be money really well spent,” according to Kumar, “because if you have a vision, and can afford to hire in this kind of climate, you can attract top talent.” Cutting-edge work underway in the chemistry department includes:

- **Participation in the Phoenix Mission to Mars:**

The department was represented among the scientists conducting the first wet chemistry experiments on another planet. The purpose was to investigate the presence of water in all its phases, to analyze the chemistry of the soil for indications of the conditions that could support life, and to identify the potential of the geochemical environment to preserve paleontological evidence. By going to Mars, Tufts chemists are participating in unraveling fundamental questions in planetary and environmental science, not the least of which are whether or not we are alone in the universe and if by understanding the history of other planets, we can learn lessons to help us better understand Earth.

- **Sensors and Single-Molecule Detection:**

Tufts chemists are doing world-renowned pioneering work that applies micro- and nanotechnology to finding new ways of measuring things. An example is the ability to etch onto fiber-optic bundles 10,000 wells that contain a single molecule each. By passing light through such

wells and collecting it on the other side, we are able to study and compare reactions on the single-molecule level. Applications for these kinds of endeavors include highly effective sensors able to detect things at very small levels. This has implications in fields ranging from medical diagnostics where certain disease states could be diagnosed from saliva, to security and the detection of explosives, to exposing contaminants in the environment.

- **Single-Molecule Surface Chemistry:**

Through work on manipulating a single molecule and by better understanding surface properties such as polarity and other factors in ferroelectric ordering, Tufts chemists are delving into areas with significant implications for a range of technological applications. By better understanding the origins of “handedness,” or chirality (favoring the left or the right), of individual molecules, researchers are gaining new knowledge of how the molecules behave on surfaces. Areas that can benefit from these discoveries include the production of high-density memory for electronics as well as catalysis that could have significant implications for the production of pharmaceuticals and applications in renewable energy.

- **Therapeutic Proteins:** Research in the chemistry department promises to greatly increase the effectiveness of protein therapeutics, a rapidly growing area of medicine. Inserting materials with Teflon-like properties, such as fluorinated amino acids, into proteins gives them the ability to resist a class of enzymes called proteases, which degrade all protein therapeutics. Making the proteins more stable can greatly benefit the usefulness of anti-diabetic drugs and also just about every drug class that is on the market. Related research is aimed at using fluorine in magnetic resonance imaging (MRI) in ways that can aid in the very early detection of certain cancers.

# Chemistry CONTINUED

## SELECTED PRINCIPAL INVESTIGATORS

### **Samuel Kounaves, Ph.D.**

Associate Professor of Chemistry, Adjunct Professor of Geology, and Research Affiliate at the NASA-Jet Propulsion Laboratory

### **Krishna Kumar, Ph.D.**

Professor of Chemistry, Department Chair, and Adjunct Professor of Biomedical Engineering

### **Charles Sykes, Ph.D.**

Usen Family Career Development Assistant Professor of Chemistry

### **Arthur L. Utz, Ph.D.**

Associate Professor of Chemistry

### **David R. Walt, Ph.D.**

Robinson Professor of Chemistry

## PARTIAL LIST OF FUNDERS

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