Krystle McLaughlin (below) explores several novel proteins in bacteriophages.

BIOLOGICAL SCIENCES

Structures of Phages

Bacteriophages, viruses that infect and replicate within bacteria, are the research focus of the biology department's SEA-Phages program. Phages are widely distributed in locations populated by bacterial hosts, such as soil or the intestines of animals, yet little is known about them. The molecular configuration of these organisms is the focus of research by structural biologist Krystle McLaughlin.

McLaughlin, professor of practice of biological sciences, is collaborating with Vassie Ware, professor of biological sciences, to structurally characterize a number of novel proteins in phages.

"In many cases, we don't know what they look like," says McLaughlin. "What is their purpose? These proteins don't have any relatives to any other proteins that we can find. Structure is a big part of function. The structure/function relationship is usually very helpful, so you can often infer what it does. Sometimes the amino acid sequence doesn't tell you all that much if it's not similar to anything else. Examining the structure will give us major insights in this case."

McLaughlin is interested in phages because of their potential to treat bacterial infections using phage therapy, which could replace antibiotics. Since many bacterial strains have antibiotic resistance, this could be the main way physicians treat bacterial infections in the future. Her research revolves around X-ray crystallographic and biochemical studies of protein-nucleic acid interactions from a range of bacterial systems. Her current project continues research initiated by Lehigh undergraduate students last summer as part of a Mountaintop project. The student researchers discovered proteins on phages and worked to express them. McLaughlin is collaborating with Ware to develop a better protein expression and to crystallize them.

McLaughlin says her work in the lab transfers to classroom discussions. Her expertise in X-ray crystallography is adding new instructional components to the department. Under McLaughlin, students have grown their own molecular crystals and examined structures in a computer program. The department has added three new biochemistry labs that discuss structures, which she says brings about new classroom dialogue.

"You can see it in a book, but it doesn't really tell how it is structured or how it interacts," she says. "To see it on the screen in 3-D is completely different. It really expands what they think about these protein complexes."

CHEMISTRY

A Better Solar Cell

A new generation of solar cells, organic solar cells may promise an answer to the energy demands of the future. These cells contain organic semiconductors and are the center of research under way in the laboratory of Mark Chen.

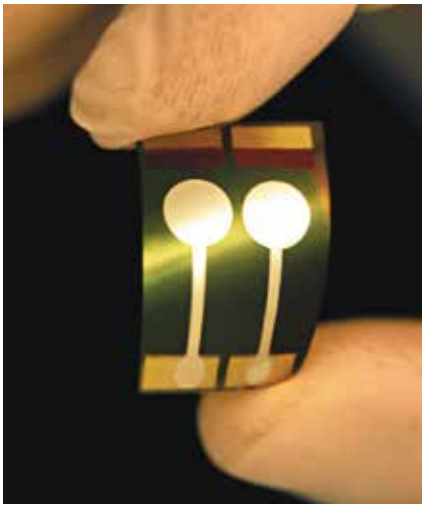
Chen, assistant professor of chemistry, studies materials design and has primarily focused on the development of polymers in emerging solar technologies. Organic semiconductors are nonmetallic, carbon-based materials that possess the ability to conduct electrons. Semiconductivity can occur with single molecules, short chains of molecules and long polymer chains, depending on the material. He is investigating ways in which these molecules can be employed to develop a better semiconductor. Chen and his colleagues are designing new compounds with semiconducting properties in the laboratory, and the work has yielded promising results in an effort to achieve power-conversion efficiencies above eight percent.

"In the laboratory, we're aiming for 10 percent," says Chen. "We currently get six or seven, but about four years ago, the best we were getting was five. It's not efficient. These devices are much thinner, and they could be complementary to commercially available silicon-based solar cells."

Organic photovoltaics (OPVs) continue to attract research attention for their potential to be flexible, lightweight and efficient devices for power generation. OPV devices convert solar energy to electrical energy. A typical OPV device consists of one or several photoactive materials sandwiched between two electrodes. Organic photovoltaic cells are solar cells that use organic polymers and small molecules as the active layer for light absorption and charge transport.

Organic semiconductors are currently employed in technologies such as flat-screen televisions, and Chen says these substances could help make solar technologies less costly. One advantage of OPV technology is that manufacturing costs can be reduced for organic solar cells compared to silicon-based materials.

"If we can use organics, sometimes they can be thinner and more efficient. Our research begins in the actual chemical synthesis, which will be followed by taking these compounds and making electronic devices with them."



The advantages of organic photovoltaic cells include low cost manufacturing technology, low raw material consumption, reduced weight, and the flexibility of the plastic substrates.