University of Manitoba

RESEARCH NEWS

Comments, submissions and event listings to:
stefaniu@ms.umanitoba.ca
Phone: (204) 474-9020
Fax: (204) 261-3475

Structural biology: the shape of things to come

By Frank Nolan, Research Promotion Officer

As you read this, proteins are regulating virtually everything you're doing. They're activating all of the chemical reactions essential to your survival, they're regulating the activity of your genes, and they're providing structural support for every one of your millions and millions of cells.

Scientists know that proteins are long chains of amino acids that typically carry out their functions by first folding into specific three-dimensional shapes. What they are still trying to find out is exactly what these three-dimensional shapes look like. That's where structural biology comes in.

In the Department of Microbiology, structural biologist Brian Mark is studying the three-dimensional arrangement of the atoms that make up proteins. Recruited last year from the Los Alamos National Laboratory in New Mexico, Mark uses a technique called protein crystallography to grow crystals made of a specific protein that can then be further studied to determine the structure of the protein itself.

"You can actually coax a protein out of a solution to grow into a very nice, uniform crystal," Mark said. "You can then mount the crystals on a machine that shines a brilliant beam of x-rays through them. Similar to the way a prism diffracts light, the crystal will diffract x-rays, giving rise to a very distinctive diffraction pattern."

As the crystal rotates in the x-ray beam, Mark collects a number of diffraction patterns and uses Fourier mathematics to combine the diffraction wavelets and calculate the three-dimensional internal structure of the crystal.

"This shows where the electrons within the crystal are located, and using this as a map, we can build a computer model of the protein structure itself," Mark said.

Knowing the specific structure of a protein can provide important insight into genetic diseases, since the normal structure of a specific protein can be compared with the molecular structure of the mutated protein.

Structural biology is also a powerful tool in designing new drugs. Based on the molecular structure of a specific target enzyme, new molecules can be designed that prevent it from functioning.

"HIV protease is now a classic example of a drug target where structural biology was used to design a small molecule to inhibit the enzyme in order to alleviate symptoms of the disease," Mark said. "This kind of drug design is much more accurate when you know what the target looks like. You can then design a small molecule that fits the target like a key fits a lock, shutting it down."

Photo by Frank Nolan

Brian Mark, microbiology, studies the three-dimensional structure and function of enzymes.

Mark said structural biology can be applied to virtually all aspects of the life sciences.

"You can use it to understand the structural basis of cellular processes, and it can help improve drug design. It also has application in protein engineering, and there's a lot of effort being put into custom enzymes that carry out certain bio-processing functions. There's a lot of interest in structural biology here in Manitoba, and I'm sure you'll see this field expanding very quickly in the next few years."

Textile scientists study more than just clothing

By Frank Nolan, Research Promotion Officer

When most of us think about textiles, what usually comes to mind is the clothing we wear. When you talk to Wen Zhong, however, you soon learn that textiles include much, much more.

"Today, apparel accounts for only about 30 per cent of the total textile market, which means that 70 per cent of that market is made up of something other than clothing," she said.

Zhong is assistant professor in the Department of Textile Sciences, which recently changed its name from clothing and textiles to reflect this reality.

"With textiles, we're basically talking about all those materials that are made from fibers," Zhong said. "Fibers are materials that have a large ratio of length versus diameter. If that ratio is larger than 100, we call the material a fiber."

Many of the materials now used in engineering applications are considered textiles. In the aerospace industry, this includes not only the materials used in the seats and carpets of an aircraft, but the materials used to build the plane itself.

"The composite materials used to build auto and aircraft parts are composed of high-performance fibers," she said. "For example, 25 per cent of the Airbus 380 is constructed of carbon fiber composite materials."

Zhong's research is focused on medical textiles, including the high-tech protective clothing worn by health care workers. The field also incorporates things like artificial blood vessels and heart valves, and the nanoscale fibrous materials used in tissue engineering.

"Right now in my lab, we have several ongoing projects," she said. "I am currently working with the Riverview Health Centre on ways we might be able to reduce the formation of pressure ulcers, or bed sores, in people who must spend long periods of time lying in bed. We're looking at synthetic textile products that might be able to reduce friction while doing a better job of transporting moisture away from the patient's skin."

Zhong said researchers in textile sciences work closely with those in other disciplines, including medicine, engineering, chemistry and physics. Zhong holds a cross appointment in the Department of Medical Microbiology, where she is applying her expertise in the transport properties of fibers to new research on biofilms.

"I'm working with medical microbiologist Michelle Alfa on a project to build computer simulations of biofilms," she said. "These are layers of bacterial colonies that can build up on the surface of medical devices, and they are very difficult to remove."

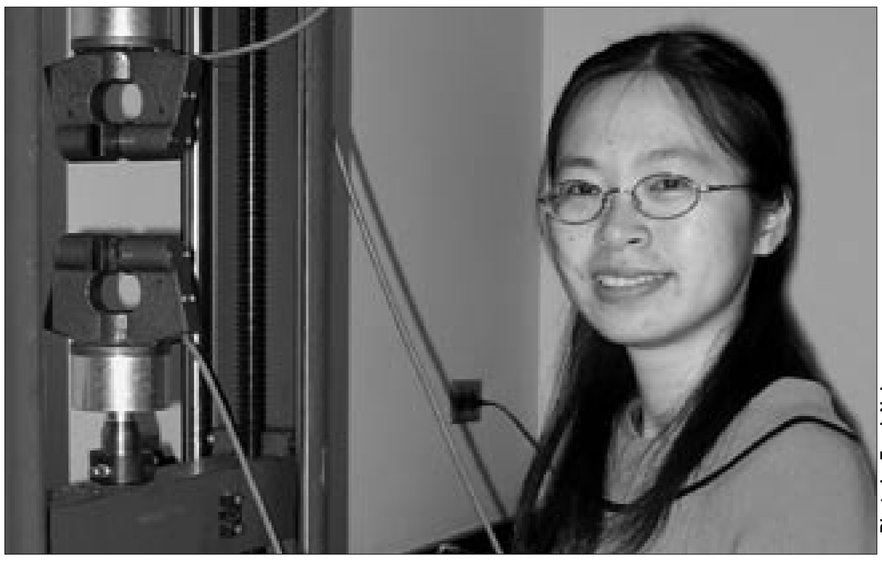

Photo by Frank Nolan

Wen Zhong, textile sciences, studies the mechanical and transport properties of medical textiles.

Zhong has done previous work with computer simulations of moisture transport through fibrous materials, and she is adapting these simulation techniques to build a computer model that can be used to study biofilms much more efficiently than traditional laboratory methods.

"Laboratory experiments can be very time consuming and expensive. It can take months to get meaningful results, so our goal is to create a computer model that can mimic the behaviour of these biofilms."

Zhong said the department plans to expand its focus on medical textiles, due to the increasing demand from Winnipeg's growing medical and bioscience research community.

"We have developed good cooperative relationships with places like the National Microbiology Laboratory, which is understandably very interested in textiles that are protective against bacteria and other potentially harmful things," she said.

Bringing Research TO LIFE

Research News is published by the Office of the Vice-President (Research)
www.umanitoba.ca/research