

K-State's chemists to develop new 'lab-on-a-chip' technologies

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The National Science Foundation has awarded \$530,000 to Kansas State University's Christopher Culbertson, assistant professor of chemistry, for his research to develop chemical analysis tools for "lab-on-a-chip" devices.

The five-year award is through the National Science Foundation's Faculty Early Career Development, or CAREER, program.

Culbertson, who joined the K-State faculty in 2002, has proposed developing universally applicable methods for detecting and identifying proteins and peptides. His method will not require tagging these molecules, as is generally necessary now to measure them at low concentrations. Rather, his chemistry, in microfluidics -- an emerging field within the realm of the nanotechnologies -- will create the basis for miniaturized, hand-held instruments capable of analyzing proteins and peptides in very small sample volumes, such as from a single white blood cell.

Proteins and peptides are key molecules in the body because they are responsible for essentially much of the communication that occurs within and between the cells, said Culbertson.

"Unregulated protein expression is responsible for various types of cancers and other genetically inherited diseases," he said.

Many proteins that are of interest in terms of disease are expressed at

very low levels normally, Culbertson said. "We have proposed an analytical method for detecting those proteins at low levels without tagging them first."

Culbertson's project goal is to miniaturize the chemical analysis instrumentation. Analytical chemists use instruments to tell what's in materials.

"We want to take an instrument that weighs 100 pounds and is 2-by-2-by-2 feet, and replace it with something that's very small and hand-held -- about the size of tape recorder -- that can do the same thing," he said.

Once lab-on-a-chip technologies are commercially available, Culbertson said scientists and medical personnel can take them to the problem or the sample under investigation. For so-called "point-of-care" diagnostics, a doctor could assess a small blood sample and quickly assess it for cancer markers, for example, he said.

People all over the country are thinking about possible applications of miniaturized analytical devices, Culbertson said. "We'll be able to monitor water quality, the quality of wheat in a grain elevator, assess grain for toxins, evaluate cargo in cargo containers, as well as do patient health evaluations at the bedside very rapidly and at low cost."

In addition to the basic scientific research of Culbertson's project, he has proposed two educational components. He will enlist high school science teachers from Kansas for summer opportunities in K-State chemistry laboratories. The experience is designed to immerse the teachers in the latest research projects.

"We think the experience in the lab will bolster their enthusiasm for experimental research, and that enthusiasm will carry over into their

classes," Culbertson said. "In the long run, we hope the teachers will influence more students toward careers in chemistry."

This aspect of Culbertson's program is being developed in collaboration with the K-State department of physics and the College of Education.

Culbertson also has proposed creating a Toastmasters' program specifically for K-State graduate students in chemistry. Students will develop better skills for giving public presentations, a beneficial aspect of any classroom or professional career, he said.

"Toastmasters' programs for graduate students are typically found associated with many professional programs, like veterinary medicine and business, where public contact and making a good impression is important," Culbertson said.

"We think helping young scientists learn to communicate technical material to the general public is very important," he said.

The CAREER program helps promote the career development of university researchers and teachers who show promise of becoming academic leaders of the 21st century. Award recipients are selected based on career development plans that creatively integrate research and education.

Source: Kansas State University

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