Scientists to Advance Biology-Liquid Crystal Research

October 11 2005

Scientists at Kent State University are poised to take biological research to a new level, thanks to a grant of $860,000 from the W. M. Keck Foundation. This is the third endorsement by the Keck Foundation received by Kent State and will be directed to the study of a new class of matter that bridges biological and liquid crystal research—biologically relevant liquid crystals.

The multi-disciplinary study, conducted by the Department of Biological Sciences in collaboration with the Glenn H. Brown Liquid Crystal Institute (LCI), focuses on biological applications of lyotropic chromonic liquid crystals (LCLCs), which, unlike the liquid crystals used in displays, are compatible with living cells. The study of LCLCs started with the goal of developing new types of optical elements such as polarizing and compensating films. Recent advances could result in further development of new technologies such as biological sensors and drug delivery systems.

The funded area of study builds upon the works of Associate Professor of Biological Sciences Dr. Christopher Woolverton and Dr. Oleg Lavrentovich, LCI director and professor of chemical physics. Woolverton and Lavrentovich have been collaborating on the use of LCLCs for the last few years, publishing and presenting their results internationally. The Keck Foundation funds will make possible the purchase of a suite of equipment essential for a deeper study of this versatile class of liquid crystals. The equipment will permit Woolverton, Lavrentovich and their students to examine nanometer scale interactions

between LCLC living cells, DNA and proteins, to reveal new information about biological systems that have liquid crystalline properties.

“Liquid crystals represent the fourth phase of matter,” said Woolverton. “The Keck Foundation grant will facilitate research on the physical and chemical properties of LCLCs, a crucial first step in understanding the liquid crystalline nature of biological systems and designing LCLC materials with predictable and controllable properties.”

Because of their compatibility with living cells, LCLCs can be used to detect harmful pathogens and microbes of the kind used in biological warfare. Woolverton and Lavrentovich already have translated bench research into prototyped devices for real-time microbial detection. Their ongoing efforts also have produced applications where LCLCs are used for controlled drug delivery and reporting agents of certain biological activities.

Certain organic materials exhibit the liquid crystalline state as they transition between the solid and the liquid states, known as mesophases. Though liquid crystals are best known for their application in displays, they also are an essential part of all life. Liquid crystals in organisms include the amphiphilic lipids of cellular membranes, the DNA in chromosomes, all proteins, especially cytoskeletal proteins, muscle proteins, collagens and proteoglycans of connective tissues. These adopt a multiplicity of mesophases that may be crucial for biological structure and function at all levels of organization, from processing metabolites in the cell to pattern determination in development, as well as the coordinated locomotion of whole organisms.

Serious scientific inquiry evaluating the relationship between liquid crystal properties and biological function began in the 1970s but was abandoned in favor of emerging research and economic opportunities

presented by liquid crystal displays and their technologies.

“Kent State is poised to become a leader in the study of biologically relevant research on many fronts because of its success in developing a multidisciplinary research approach in the hard sciences,” said Kent State President Dr. Carol A. Cartwright. “We are delighted to have the backing of the W.M. Keck Foundation, whose reputation for investing in innovative and emerging research makes it an excellent partner at this early and critical juncture in this important, emerging field.”

Founded in 1910 as a teaching school, today Kent State University is Ohio’s second largest public university, and the largest residential university in Northeast Ohio. Serving more than 35,000 students and offering more than 272 academic programs at the associate, baccalaureate, master’s and doctoral levels, Kent State ranks among the top 90 public universities in the country, an elite group of the nation’s nearly 3,900 colleges and universities, according to the Carnegie Foundation for the Advancement of Teaching.

Based in Los Angeles, the W. M. Keck Foundation was established in 1954 by the late W. M. Keck, founder of the Superior Oil Company. The foundation also maintains a program to support undergraduate science and humanities education and a Southern California Grant Program that provides support in the areas of health care, civic and community services, education and the arts, with a special emphasis on children.

Source: Kent State University