New Device Shines Light on Disease-Causing Molecules

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If a doctor could identify a single molecule indicating the presence of a disease before the disease has a chance to harm the patient, the practice of medicine and the health of patients would be greatly improved. That's the potential of a new device being developed by a University of Missouri engineer that is designed to aid in the diagnosis of disease. This technique, which is based on light detection, is sensitive enough to potentially identify a single disease molecule.

"We know this may be a good approach—maybe even a revolutionary approach—but how much better we can do is still being tested," said Xudong "Sherman" Fan, assistant professor of biological engineering in MU's College of Engineering.

Fan recently received the National Science Foundation's CAREER Award to study how a device he created to amplify light waves can be used to more clearly identify antigens, which are molecules inside the body that indicate disease. The $400,000 grant will be given over five years, beginning July 1.

Current biomedical technology chemically attaches color-coded fluorescent molecules—known as tags—to antibodies and antigens to find out whether an antibody molecule has latched on to an antigen. The color that analysts see after they have put antibody and antigen molecules together indicates what is happening on the molecular level. For example, an antibody might be labeled with a green tag and an antigen labeled with a red tag. If the antibody has not bound to the

antigen, analysts will see only the color green. If the antibody and the antigen have bound, only red is visible.

This color change may be too faint to detect when only a few antigens exist, preventing diagnosis of the disease. Fan's device, called an opto-fluidic ring resonator (OFRR), greatly amplifies and clarifies those color changes by circulating the tagged light through a glass ring that is specifically shaped to reflect and strengthen light waves. The device increases sensitivity so much that even a single molecule of disease may be detectable, Fan said.

"The OFRR technology has tremendous applications in many different fields," Fan said.

The same core technology forms the basis of another of Fan's devices that is capable of rapidly detecting cancer molecules using only a small blood sample. The device tests for a number of proteins or DNA molecules that, if found together, indicate cancer. Fan said this device, which will undergo clinical tests later this year, will enable doctors to detect cancer accurately and quickly.

"Within one doctor's visit, you could get results," he said. "You wouldn't have to send a sample to a pathologist's office and wait."

Fan's research on OFRR applications has been published in more than 20 peer-reviewed articles in journals such as *Optics Letters, Applied Physics Letters* and *Optics Express.*

Source: University of Missouri