Pocket chemistry: DNA helps glucose meters measure more than sugar

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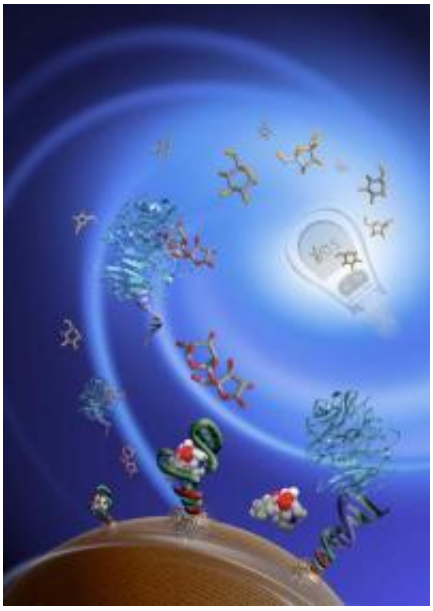

University of Illinois chemists coupled functional DNA sensors and glucose meters for fast, easy, portable detection of drugs, toxins, disease markers and other molecules in blood, water or food. Credit: Li Huey Tan, Yu Xiang and Yi Lu

Glucose meters aren't just for diabetics anymore. Thanks to University of Illinois chemists, they can be used as simple, portable, inexpensive meters for a number of target molecules in blood, serum, water or food.

Chemistry professor Yi Lu and postdoctoral researcher Yu Xiang published their findings in the journal *Nature Chemistry*.

"The advantages of our method are high portability, low cost, wide availability and quantitative detection of a broad range of targets in medical diagnostics and environmental monitoring," Lu said. "Anyone could use it for a wide range of detections at home and in the field for targets they may care about, such as vital metabolites for a healthy living, contaminants in their drinking water or food, or potential disease markers."

A glucose meter is one of the few widely available devices that can quantitatively detect target molecules in a solution, a necessity for diagnosis and detection, but only responds to one chemical: glucose. To use them to detect another target, the researchers coupled them with a class of molecular sensors called functional DNA sensors.

Functional DNA sensors use short segments of DNA that bind to specific targets. A number of functional DNAs and RNAs are available to recognize a wide variety of targets.

They have been used in the laboratory in conjunction with complex and more expensive equipment, but Lu and Xiang saw the potential for partnering them with pocket glucose meters.

The DNA segments, immobilized on magnetic particles, are bound to the enzyme invertase, which can catalyze conversion of sucrose (table sugar) to glucose. The user adds a sample of blood, serum or water to the functional DNA sensor to test for drugs, disease markers, contaminants or other molecules. When the target molecule binds to the DNA, invertase is released into the solution. After removing the magnetic particle by a magnet, the glucose level of the sample rises in proportion to the amount of invertase released, so the user then can employ a glucose meter to quantify the target molecule in the original sample.

"Our method significantly expands the range of targets the glucose

monitor can detect," said Lu, who also is affiliated with the Beckman Institute for Advanced Science and Technology and with the Frederick Seitz Materials Research Lab at U. of I. "It is simple enough for someone to use at home, without the high costs and long waiting period of going to the clinics or sending samples to professional labs."

The researchers demonstrated using functional DNA with glucose meters to detect cocaine, the disease marker interferon, adenosine and uranium. The two-step method could be used to detect any kind of molecule that a functional DNA or RNA can bind.

Next, the researchers plan to further simplify their method, which now requires users to first apply the sample to the functional DNA sensor and then to the glucose meter.

"We are working on integrating the procedures into one step to make it even simpler," Lu said. "Our technology is new and, given time, it will be developed into an even more user-friendly format."

Provided by University of Illinois at Urbana-Champaign

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