Chemists demonstrate sensor technology that could detect, monitor diabetes through breath analysis alone

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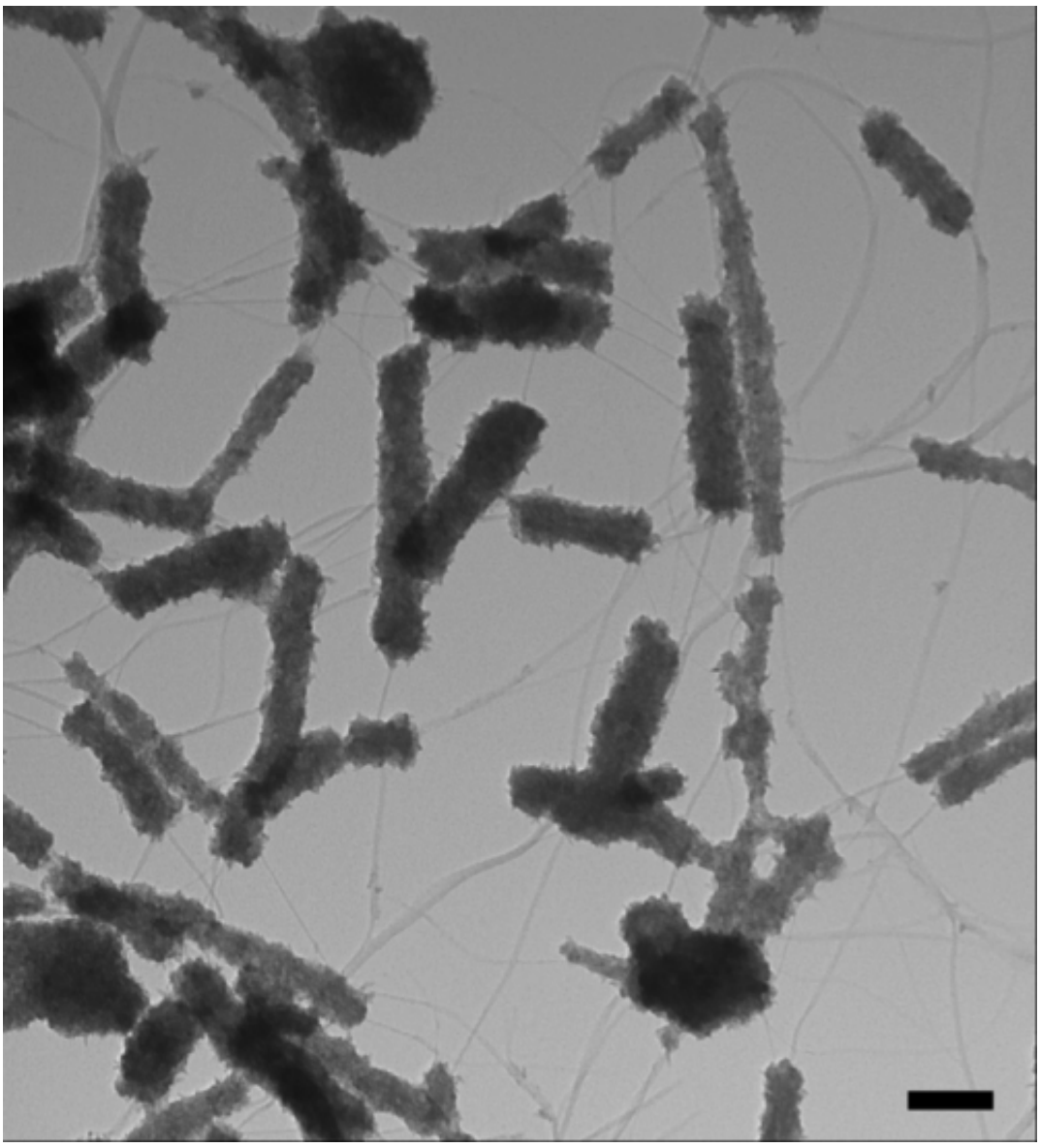

A transmission electron microscopy image of the hybrid material revealing the formation of “titanium dioxide on a stick.”

(Phys.org) —Diabetes patients often receive their diagnosis after a series of glucose-related blood tests in hospital settings, and then have to monitor their condition daily through expensive, invasive methods. But what if diabetes could be diagnosed and monitored through cheaper, noninvasive methods?

Chemists at the University of Pittsburgh have demonstrated a sensor technology that could significantly simplify the diagnosis and monitoring of diabetes through breath analysis alone. Their findings were published in the latest issue of the *Journal of the American Chemical Society* (*JACS*).

Even before blood tests are administered, those with diabetes often recognize the condition's symptoms through their breath acetone—a characteristic "fruity" odor that increases significantly during periods of glucose deficiency. The Pitt team was interested in this biomarker as a possible diagnostic tool.

"Once patients are diagnosed with diabetes, they have to monitor their condition for the rest of their lives," said Alexander Star, principal investigator of the project and Pitt associate professor of chemistry. "Current monitoring devices are mostly based on blood glucose analysis, so the development of alternative devices that are noninvasive, inexpensive, and provide easy-to-use breath analysis could completely change the paradigm of self-monitoring diabetes."

Together with his colleagues—Dan Sorescu, a research physicist at the National Energy Technology Laboratory, and Mengning Ding, a Pitt

graduate student studying chemistry—Star used what's called a "sol-gel approach," a method for using small molecules (often on a nanoscale level) to produce solid materials. The team combined titanium dioxide—an inorganic compound widely used in body-care products such as makeup—with carbon nanotubes, which acted as "skewers" to hold the particles together. These nanotubes were used because they are stronger than steel and smaller than any element of silicon-based electronics.

This method, which the researchers playfully call "titanium dioxide on a stick," effectively combined the electrical properties of the tubes with the light-illuminating powers of the titanium dioxide. They then created the sensor device by using these materials as an electrical semiconductor, measuring its electrical resistance (the sensor's signal).

The researchers found the sensor could be activated with light to produce an electrical charge. This prompted them to "cook" the "skewers" in the sensor under ultraviolet light to measure acetone vapors—which they found were lower than previously reported sensitivities.

"Our measurements have excellent detection capabilities," said Star. "If such a sensor could be developed and commercialized, it could transform the way patients with diabetes monitor their glucose levels."

The team is currently working on a prototype of the sensor, with plans to test it on human breath samples soon.

More information: The paper, "Photoinduced Charge Transfer and Acetone Sensitivity of Single-Walled Carbon Nanotube-Titanium Dioxide Hybrids," was first published in *JACS* online June 5.

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