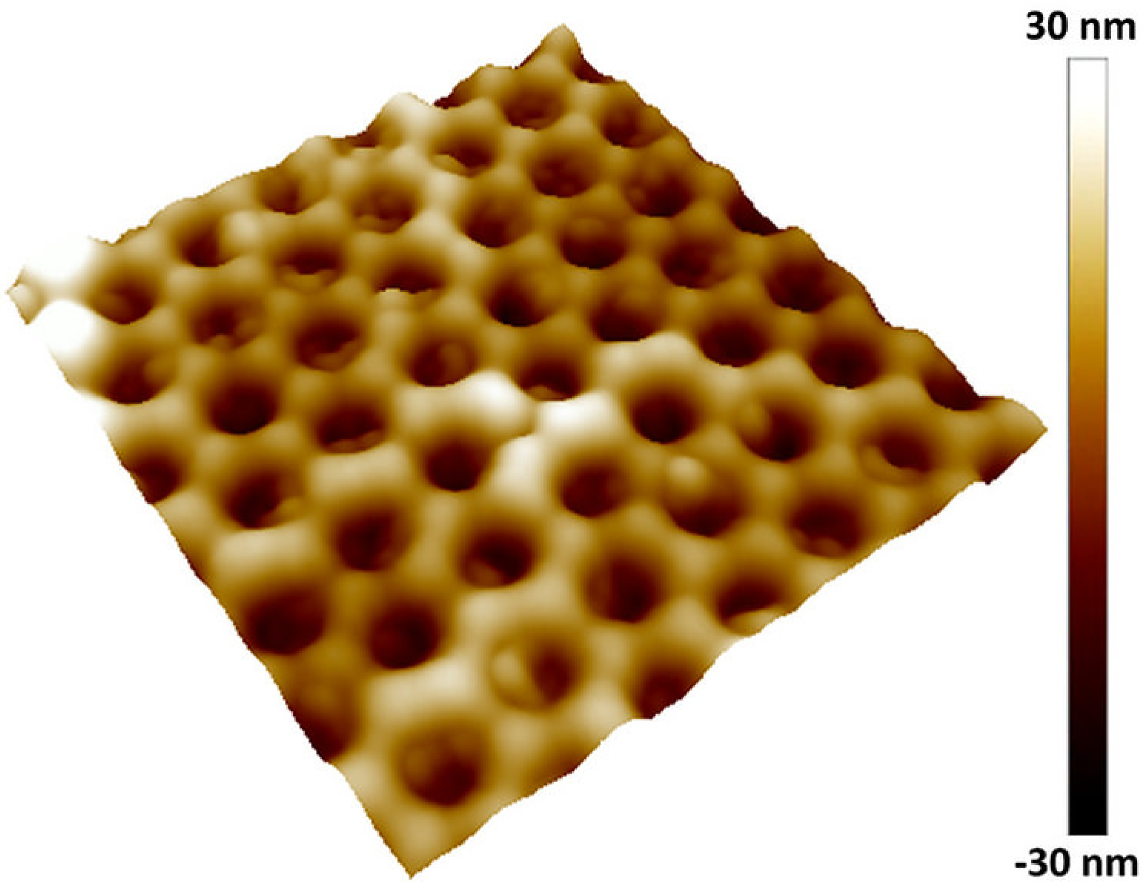
Glucose-monitoring contact lens would feature transparent sensor

November 2 2016



Transistor's nanostructure. Credit: Oregon State University

Type 1 diabetes patients may one day be able to monitor their blood glucose levels and even control their insulin infusions via a transparent sensor on a contact lens, a new Oregon State University study suggests.

The sensor uses a nanostructured transistor – specifically an amorphous indium gallium oxide field effect transistor, or IGZO FET – that can detect subtle glucose changes in physiological buffer solutions, such as the tear fluid in eyes.

Type 1 diabetes, formerly known as juvenile diabetes, can lead to serious health complications unless glucose levels are carefully controlled. Problems can include retinopathy, blindness, neuropathy, kidney and cardiac disease.

Researchers in the OSU College of Engineering say sensors they fabricated using the IGZO FET will be able to transmit real-time glucose information to a wearable pump that delivers the hormones needed to regulate blood sugar: insulin and glucagon.

The sensor and pump would, in effect, act as an artificial pancreas.

"We have fully transparent sensors that are working," said Greg Herman, an OSU professor of chemical engineering and corresponding author on this study. "What we want to do next is fully develop the communication aspect, and we want to use the entire contact lens as real estate for sensing and communications electronics.

"We can integrate an array of sensors into the lens and also test for other things: stress hormones, uric acid, pressure sensing for glaucoma, and things like that. We can monitor many compounds in tears – and since the sensor is transparent, it doesn't obstruct vision; more real estate is available for sensing on the contact lens."

The FET's closely packed, hexagonal, nanostructured network resulted from complimentary patterning techniques that have the potential for low-cost fabrication. Those techniques include colloidal nanolithography and electrohydrodynamic printing, or e-jet, which is somewhat like an inkjet printer that creates much finer drop sizes and works with biological materials instead of ink.

The findings by postdoctoral scholar Xiaosong Du, visiting scholar Yajuan Li and,Herman were recently published online in the journal *Nanoscale*. The Juvenile Diabetes Research Foundation provided primary funding for the research.

Google has been working on a glucose-monitoring contact lens but its version is not fully transparent.

"It's an amperometric sensor and you can see the chips—that means it has to be off to the side of the contact lens," Herman said. "Another issue is the signal is dependent on the size of the sensor and you can only make it so small or you won't be able to get a usable signal. With an FET sensor, you can actually make it smaller and enhance the output signal by doing this."

This research builds on earlier work by Herman and other OSU engineers that developed a glucose sensor that could be wrapped around a catheter, such as one used to administer insulin from a pump.

"A lot of type 1 diabetics don't wear a pump," Herman said. "Many are still managing with blood droplets on glucose strips, then using self-injection. Even with the contact lens, someone could still manage their diabetes with self-injection. The sensor could communicate with your phone to warn you if your glucose was high or low."

The transparent FET sensors, Herman said, might ultimately be used for cancer detection, by sensing characteristic biomarkers of cancer risk. Their high sensitivity could also measure things such as pulse rate, oxygen levels, and other aspects of health monitoring that require precise control.

More information: Xiaosong Du et al. A field effect glucose sensor with a nanostructured amorphous In–Ga–Zn–O network, *Nanoscale* (2016). [DOI: 10.1039/C6NR05134K](https://doi.org/10.1039/C6NR05134K)

Provided by Oregon State University