Super-quick COVID-19 Test Uses New Optical Technology

2023-01-27
Norway's NTNU and partners use graphene nanosensors to quickly detect coronavirus in blood.

Researchers from the Norwegian University of Science and Technology (NTNU), Oslomet, and the University of Tabriz in East Azerbaijan, have demonstrated a new method for detecting coronavirus in blood samples using nanosensors.

"A lot of research focuses on finding methods to quickly isolate infected people, which can break the chain of infection. Nanosensors have received a lot of attention due to their unique properties for ultra-fast detection of particles such as viruses," said Amir Maghoul. He is a researcher and the first author of the article An Optical Modeling Framework for Coronavirus Detection Using Graphene-Based Nanosensor, published in Nanomaterials.

Maghoul was a post-doctoral fellow at NTNU when he started his work. A first step on the pathway to developing a separate nanosensor for the coronavirus is to identify the optical properties that distinguish the coronavirus from other particles in human blood.

Ingve Simonsen, a physics professor at NTNU, explains: "Most people have seen the coronavirus depicted as a round core or ball with spikes sticking out. We wanted to see what role the length and size of these spikes play in how the cells reflect light, as well as whether the size of the nucleus matters."

To find answers to their questions, the researchers used mathematical models. The optical behavior of the virus—that is, how the virus cell reflects light in the form of resonance—was simulated and analyzed over the entire light spectrum. "We observed that the reflectivity varied with the length of the spike proteins. As the spikes get longer, the reflectivity

decreases at the same time as the resonance shifts to higher wavelengths," said Simonsen.

The researchers observed the same response when they varied the size of the virus' core in the models. The width of the spike protein had less effect on how the light was reflected. In this way, the researchers could find out in which part of the wavelength spectrum the coronavirus differs from other particles in the blood.

“At certain wavelengths, we get a different optical response depending on whether viruses are present or not. We call this the optical signature of the coronavirus,” said Simonsen. “We know that the optical properties of particles change depending on their environment. They behave differently if they're in water or in a vacuum, if several particles are next to each other or if the surface is covered with a thin layer of another substance.”

Graphene is key to the new Covid-19 test method.

Versatile graphene

“What we do is place a network of thin, cylindrical gold particles over a very thin layer of graphene. Graphene is a nanomaterial with a lot of fascinating properties, including the fact that it conducts electricity well and with little loss.”

When blood containing the coronavirus passes over the gold particles, the resonant frequency of the particles changes, which in turn creates an electromagnetic field. This field sets up a current in the sensor that can be easily measured. “By studying the current curves for certain frequency ranges of the incoming light, we can determine whether the blood contains coronavirus or not,” said Simonsen.

Nanosensors have the potential to be very sensitive. The smart graphene material in the nanodisk acts as an amplifier, said Maghoul.

“Nanotechnology hasn’t been used before for this type of sensor, so this development is new technology. What we've done here is create the first optical framework to detect coronavirus and show how the virus behaves in the optical spectrum,” said Maghoul. Now the next step is to establish a company that can develop a laboratory prototype for the nanosensor.

“We need to raise money so that we can go ahead and develop a sensor for common use. The collaboration between NTNU and Oslomet has shown that we have facilities with significant potential to develop and produce this type of nanosensor for biomedical use if the work is supported financially,” said Maghoul.

Read the original article on Optics.