An aptasensor has been designed to detect the SARS-CoV-2 virus in saliva

December 20 2021

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Scientists at the Universidad Carlos III de Madrid (UC3M) have developed the first photo-electrochemical aptasensor that detects the SARS-CoV-2 virus in a saliva sample. This sensor, which uses aptamers (a type of artificial antibody), is more sensitive that antigen-based sensors and detects the virus more quickly and cheaply than PCR tests. These new devices can be incorporated into portable diagnostic systems and are easy to use.

The new aptasensor has a wide range of sensitivity to different virus

concentrations. It is thus capable of detecting concentrations below 0.5 nanomolars (nM), typical in patients who have not yet developed COVID symptoms, as well as working at higher concentrations (up to 32 nM), so it could provide clinical practices with an extra tool for monitoring the progress of infection in patients.

It would be used in a similar way to current antigen sensors: a sample of the patient's saliva is dissolved in a buffer solution and then placed on to the sensor's surface. The measurement would be available in a few minutes. "The advantage over current antigen-based sensors is the greater sensitivity and specificity of the photo-electrochemical sensor measurements, which are comparable to more complex measurements, such as those from fluorescence-based sensors, and they are simpler, cheaper, and faster than PCR-based sensors," says the research's lead author, Mahmoud Amouzadeh Tabrizi, CONEX-Plus researcher at the UC3M's Department of Electronic Technology.

The science behind the aptasensor

A photo-electrochemical sensor can be likened to a solar cell or the process of photosynthesis: in both cases, given the presence of light (photons), a specific material (or molecule) is able to generate an electrical current (electrons). "In our case, we used a surface that contains graphitic carbon nitride-cadmium sulfide quantum dots (C_3N_4-CdS) with photoactive properties. It is on this surface that a specific receptor is immobilized in such a way that, in the presence of the target molecule, it binds to the bioreceptor, thereby reducing the current generation associated with the presence of light. On this particular sensor, the bioreceptor used is an aptamer that is capable of interacting with the receptor-binding domain (RBD) of the SARS-CoV-2 virus, hence the name photo-electrochemical aptasensor," explains Mahmoud Amouzadeh Tabrizi. The results of this and other research by the group concerning the detection of SARS-CoV-2 in saliva

were recently published in several scientific journals, such as *Sensors and Actuators B: Chemical* and *Biosensors and Bioelectronics*.

"The idea now is to supplement these results, using the research group's experience, with the development of comprehensive biomedical instruments and diagnostics in order to create a high-sensitivity and specificity, portable and potentially low-cost diagnostic system that can eventually be used in clinical practice," notes another of the authors, Pablo Acedo, head of the UC3M's Sensors and Instrumentation Techniques Group (SITec). "We are seeking a diagnosis similar to those currently available when reading blood glucose levels in patients with diabetes, for example. We are also aiming to contact companies that may be interested in these developments," he adds.

A critical factor when manufacturing this type of nanomaterial-based electrochemical sensor involves correctly characterizing the surface of the material and the receiver that is immobilized on the surface. In order to do this, researchers have used various techniques and technologies, such as scanning electron microscopes (SEM), atomic force microscopy (AFM), and fourier-transform infrared spectroscopy (FTIR). "The results obtained from using all of these techniques allow us to ensure that both the manufacture of the desired photosensitive nanomaterial and the immobilization of the bioreceptor has been properly carried out," says Pablo Acedo.

More information: Mahmoud Amouzadeh Tabrizi et al, A photo-electrochemical aptasensor for the determination of severe acute respiratory syndrome coronavirus 2 receptor-binding domain by using graphitic carbon nitride-cadmium sulfide quantum dots nanocomposite, *Sensors and Actuators B: Chemical* (2021). DOI: 10.1016/j.snb.2021.130377

Mahmoud Amouzadeh Tabrizi et al, An ultrasensitive molecularly

imprinted polymer-based electrochemical sensor for the determination of SARS-CoV-2-RBD by using macroporous gold screen-printed electrode, *Biosensors and Bioelectronics* (2021). DOI: 10.1016/j.bios.2021.113729

Provided by Carlos III University of Madrid