Graphene sensors for ultrasensitive detection of SARS-CoV-2

- Researchers at CIC biomaGUNE are involved in the development of a novel mechanism to detect pathogens; graphene is used and there has been a substantial improvement in the sensitivity achieved to date.
- This collaborative work lays the groundwork for a new class of analytical platforms with the potential to detect a wide variety of pathogens even before their isolation.
- The result promises to be a powerful tool in the fight against future pandemics.

The pandemic emergency caused by COVID-19 has highlighted the limitations of the current diagnostic tests, as well as the urgency to develop faster, more accurate and sensitive sensors. Researchers from CIC biomaGUNE, Graphenea, BCMaterials and the University of A Coruña have come up with an ultrasensitive pathogen detector using graphene for the detection of SARS-CoV-2 (the virus responsible for COVID-19). This detector is based on the interaction between a protein of the virus SARS-CoV-2 and a protein common to the membranes of human cells of many internal organs (ACE2).

Viruses replicate inside the cells of other organisms; they enter the cell to transmit their genetic information and reproduce. The ACE2 protein serves as a point of entry for different viruses, enabling them to infect cells. SARS-CoV-2 is covered with small spike-like proteins (spike proteins), which bind to ACE2 proteins in cells, initiating a process that allows the virus to release its genetic material into a healthy cell.

The sensor takes advantage of this interaction to detect, with unprecedented sensitivity, the presence of the spike protein. This new technology makes it possible to detect extremely low virus concentrations: “We have shown that by coupling this ACE2 protein to this detection platform, it is possible to detect spike protein concentrations of several attomolars (equivalent to detecting one virus per microliter of sample),” explained the CIC biomaGUNE researcher Alessandro Silvestri, one of the authors of the research.

The technology built up offers the possibility of detecting other pathogens, thus laying the foundations for a new class of analytical platforms. It has the potential to detect a whole range of pathogens, even before they have been isolated, which proves that it is a powerful tool in the fight against future pandemics.

The spike protein, present in a range of viruses, is what defines the infectivity of a virus. “Using these two proteins, ACE2 and the spike protein, we can study whether a virus is infectious, before finding out which virus it is. We can find out whether a virus can infect humans within a much shorter time interval than before,” explained Silvestri, a researcher in CIC biomaGUNE’s Carbon Bionanotechnology Group. This is one of the great novelties of the work published in the high-impact scientific journal *Nanoscale*.

The researcher did, however, point out the need for further research to study the interaction between different proteins expressed in human cells and different types of viruses, “because each virus has a human cell protein that is involved in its internalization.”

This study has served to prove the validity of such devices, and paves the way for the development of more rapid, accurate and sensitive diagnostics for existing and future pathogens.

Bibliographic reference

Ultrasensitive detection of SARS-CoV-2 spike protein by graphene field-effect transistors
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