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Panorama View of Most Voguish Field Effect Transistor (FET) Based Biosensors

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Article History

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Biosensors have been widely used in a variety of applications since its inception by Clark *et.al.,* in 1962 including cancer diagnosis, toxin detection, food analysis, health prognosis, etc.[1-5] A biological receptor and a physical-chemical transducer are typically combined to form biosensors, analytical devices that translate biological responses into electrical signals.While the latter translates responses from the biochemical domain, generally an analyte concentration, into a chemical or physical output signal with a predetermined sensitivity, the former transfers the signal from the output domain of the bio-recognition system, frequently to the electrical domain.[6] Field-effect transistor biosensors (Bio-FETs), which combine ion-sensitive field-effect transistors (ISFET) with bio-receptors, have emerged as the most developed options among the numerous types of biosensors due to a number of benefits.

The interpretation and translation is the key factor in every biosensor and it can be done by an appropriate bio/semibio-material. The two most common nanomaterials that scientists are particularly interested in are those based on carbon (graphene and carbon nanotubes, or CNTs), as well as silicon (silicon nanowire, or SiNW). Because silicon nanowire is practical for mass manufacturing in the semiconductor industry, it has been shown to have great sensitivity for label-free and real-time detection.[7,8]

Since its invention, graphene, one of the standard materials, has been overused for FET-biosensors. However, attention has been focused on graphene FET (GFET) advancements as nanotransducers continuously up to now. A new type of GFET biosensorusing graphene foam as an electrical channel used to detect adenosine triphosphate (ATP). Porous/hollow structures of three-dimensional(3D) graphene and Al_2O_3 embeded reduced graphene oxide (rGO) channel are the very common structure of the Graphene

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in the field of Biosensors. Most effective, amongst rGo and 3D graphene, Nanopore-extended FET (nexFET), developed by Ren's team, provides improved molecular through put, bettered signal-to-noise ratios, and enhanced selectivity by functionalization with an implanted receptor.[9,10] Certainly, exceptional qualities of Graphene, including as strong electrical conductivity, high carrier mobility, and wide specific area, have made it a suitable material for a variety of sensing platforms. FET biosensors based on graphene can sense surface changes from their surroundings and offer the best sensing environment for ultrasensitive and low-noise detection. This makes graphene-based FET technology particularly appealing for uses involving delicate immunological diagnostics.

During the pandemic period, the whole world wants to detect the novel corona virus (COVID-19) accurately and in very short time spam of measurement. For a quick and reliable diagnosis of COVID-19, highly sensitive immunological diagnostic techniques that can directly identify viral antigens in clinical samples without sample preparation processes are required. In this era, FET based biosensors evolved at its extreme and shows the promising and reliable data for detecting corona virus. The detection of the SARS-CoV-2 virus using a graphene-based biosensing device, functionalized with SARS-CoV-2 spike antibody (COVID-19 FET sensor). By the employment of 1-pyrenebutyric acid N-hydroxysuccinimide ester (PBASE), an efficacious interface matching agent employed as a probe linker, SARS-CoV-2 spike antibody was mounted onto the constructed device, with capacity to detect SARS-CoV-2 antigen protein with a limit of detection (LOD) of 1 fg/mL.[11]

SARS-CoV-2 is a highly infectious virus that is presently circulating widely over the world. In contrast to SARS and MERS, COVID-19 spreads at a significantly quicker rate. Additionally, reports of asymptomatic COVID-19 transmission have surfaced. This kind of situation required primary and quick detection that is possible using Real-time reverse transcription polymerase chain reaction (RT-PCR) test. Now days, RT-PCR is available very commonly in a very affordable prize.Such kind of SARS-CoV-2 virus cultured device also demonstrated no measurable cross-responsiveness with MERS CoV antigen, which is also a prerequisite of the COVID sensor. In addition to these, graphene's characteristics enable it to be customized for a variety of uses, including biosensors, gas sensors, capacitors, solar cells etc.

Reference

1. Clark, L.C., Jr.; Lyons, C.,Ann. N. Y. Acad. Sci. 1962, 102, 29–45.
2. Tothill, I.E.Semin. Cell Dev. Biol.,2009, 20, 55–62.
3. Ligler, F.S.; Taitt, C.R.; Shriver-Lake, L.C.; Sapsford, K.E.; Shubin, Y.; Golden, J.P., Anal. Bioanal. Chem. 2003, 377, 469–477.
4. Bunney, J., Williamson, S., Atkin, D., Jeanneret, M., Cozzolino, D., Chapman, J., Power, A., Chandra, S.,Curr. Res. Nutr. Food. Sci. 2017, 5, 83–95.
5. Pantelopoulos, A.; Bourbakis, N.G., IEEE Trans. Syst. Man Cybern. Syst. 2010, 40, 1–12.
6. Thevenot, D.R.; Toth, K.; Durst, R.A.;Wilson, G.S.,Biosens. Bioelectron. 2001, 16, 121–131.
7. Cui, Y., Wei, Q., Park, H., Lieber, C.M., Science 2001, 293, 1289–1292.
8. Zheng, G., Patolsky, F., Cui, Y., Wang, W.U., Lieber, C.M., Nat. Biotechnol. 2005, 23, 1294–1301.
9. Ren, R., Zhang, Y., Nadappuram, B.P., Akpinar, B., Klenerman, D., Ivanov, A.P., Edel, J.B., Korchev, Y. Nat. Commun. 2017, 8, 586.
10. Singh, Nihal; Kalotra, Pankaj; Srivastava, Subodh, Sharma, S. S., Advanced Science, Engineering and Medicine, 2019, 11 (1-2) 92-94
11. GiwanSeo, Geonhee Lee, MiJeong Kim, Seung-HwaBaek, Minsuk Choi, Keun Bon Ku, Chang-Seop Lee, Sangmi Jun, Daeui Park, Hong Gi Kim, Seong-Jun Kim, Jeong-O Lee, Bum Tae Kim, Edmond Changkyun Park, and Seung Il Kim, ACS Nano 2020, 14(4), 5135–5142