Advances in Bioresearch
Adv. Biores., Vol 11 (3) May 2020: 03-04

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.11.3.34

Advances in Bioresearch

PERSPECTIVE ARTICLE

Graphene biosensor: Rapid and Accurate diagnostic method of COVID-19 (SARS-CoV-2)

Vishal Khandelwal[1]*, Taruwala Sharma[1], Manish Kumar[2] & Deepmala Verma[3]
[1*] Department of Biotechnology, GLA University, Matura (U.P)
[2] Department of Zoology, Narain College, Shikohabad (U.P)
[3] Department of Zoology, SS Jain Subodh (Autonomous) PG College, Jaipur (Raj.)

ABSTRACT
Outbreak of COVID-19 pandemic is the most staggering scene ever experienced in the 21 st century. Rapid and broad application of testing accelerates isolation and treatments of COVID- 19 patient in early stage until vaccine or specific drug for COVID-19 are not developing. Here, field-effect transistor (FET)-based biosensing device utilizes graphene sheets and specific antibodies against spike protein of SARS-CoV-2 for the detection of SARS-CoV-2 from clinical samples like nasopharyngeal swab, cultured virus or antigen protein from the patient.
Keywords- COVID-19, SARS-CoV-2, Biosensor, FET

Received 02.04.2020 Revised 18.04.2020 Accepted 16.05.2020

How to cite this article:
V Khandelwal, T Sharma, M Kumar & D Verma. Graphene biosensor: Rapid and Accurate diagnostic method of COVID-19 (SARS-CoV-2). Adv. Biores., Vol 11 (3) May 2020: 03-04

Since its discovery in Hubei Province China in December 2019, COVID-19 has spread globally and been promulgated as a pandemic by WHO (World Health Organisation) on 11th March 2020. Outbreak of this viral induced respiratory distress syndrome makes a pause on the world and become major health concern globally. Outbreak of this pandemic virus can be interrupted by early detection, isolation and prompt treatment [1]. Currently, there are 4.12 million confirm active cases of SARS-CoV-12 worldwide with 284152 deaths [2].

National Medical Products Administration (NMPA), China, approved 11nucleic acid based methods and 8antibody detection kits for the diagnosis of SARS-CoV-2. Laboratory tests available for the diagnosis of SARS-CoV-2 includes RT-PCR, immunological tests for the detection of antibodies and antigens, viral culture techniques for the isolation of virus, indirect fluorescent antibody techniques, immunofluorescent techniques and rapid immunochromatographic tests assisted by CD4+ and CD8+ T cell counts through flow cytometric analysis, demonstration of lymphopenia with complete blood picture, chest radiography (pneumonia) and serum biochemistry (serum protein and others) [3]. Each described technique comprises its own drawbacks. RT-PCR is most widely used for the diagnosis of SARS-CoV-2 but it takes at least 3 hours including preparation of viral RNA which can also affect diagnostic accuracy. Now it becomes necessary to develop highly sensitive immunological diagnostics for more rapid and accurate diagnosis and to manage COVID-19 outbreak and prevention of future epidemics. Biosensors can also used as a powerful tool for effective assessment of clinical progress [4]. Some incredible properties of Graphene including antibacterial and antiviral, inveigle researchers of all over the world and makes it a beneficial trait for medical sensor in combat with corona pandemic.

A team of Korean researchers have developed a graphene-based field-effect transistor-based biosensor that detects SARS-CoV-2 in nasopharyngeal swabs from patient with COVID-19, in less than one minute. Graphene is thinnest known material, arranged in a hexagonal lattice of one-atom-thick layer of carbon atoms. This material repeatedly entitled as "wonder material" because of its remarkable substance with a multitude of astonishing properties like electronic conductivity, large specific area and high carrier mobility [5].

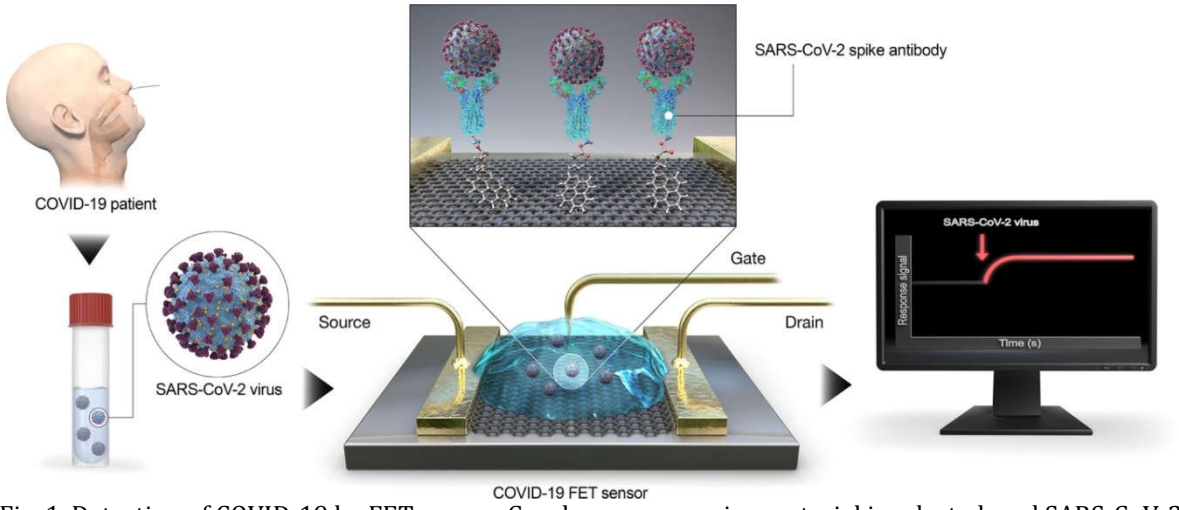

Fig. 1. Detection of COVID-19 by FET sensor. Graphene as a sensing material is selected, and SARS-CoV-2 spike antibody is conjugated onto the graphene sheet *via* 1-pyrenebutyric acid *N*-hydroxysuccinimide ester, which is an interfacing molecule as a probe linker.([Source: Seo *et al* [6])

In this assay, they developed a graphene based biosensing device functionalized with SARS-CoV-2 spike antibody (COVID-19 FET sensor) and used it as detection platform on which spike antibodies of SARS-CoV-2 immobilized through 1-pyrenebutyric acid N-hydroxysuccinimide ester (PBASE) which is an efficient interface coupling agent. They used cultured SARS-CoV-2 virus, nasopharyngeal swab and clinical samples to confirm its potential for clinical application. From the four structural proteins of SARS-CoV-2, they utilises spike proteins because it's a major transmembrane protein and is highly immunogenic. Therefore spike protein antibodies used as a receptor to detect virus. After the immobilisation of spike protein on graphene surface electrical measurements were carried out. Different slops indicate the successful introduction of SARS-CoV-2 spike proteins. When purified spike protein or cultured viral sample is applied to the sensor, binding to the antibody caused a change in the electric current. This sensor can easily discriminate between samples from healthy and sick patient [6].

REFERENCES

1. Sohrabi, C., Alsafi, Z., O'Neill, N., Khan, M., Kerwan, A., Al-Jabir, A., & Agha, R. (2020). World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *International Journal of Surgery*. Volume 76, April 2020, Pages 71-76
2. https://www.worldometers.info/coronavirus/
3. Udugama, B., Kadhiresan, P., Kozlowski, H. N., Malekjahani, A., Osborne, M., Li, V. Y., & Chan, W. C. (2020). Diagnosing COVID-19: the disease and tools for detection. *ACS nano*. 14, 4: 3822-3835. https://doi.org /10.1021/ acsnano.0c02624
4. Morales-Narváez, E., & Dincer, C. (2020). The impact of biosensing in a pandemic outbreak: COVID-19. *Biosensors and Bioelectronics*, 112274.
5. https://www.graphene-info.com/new-graphene-biosensor-can-detect-sars-cov-2-under-minute
6. Seo, G., Lee, G., Kim, M. J., Baek, S. H., Choi, M., Ku, K. B., & Kim, S. J. (2020). Rapid Detection of COVID-19 Causative Virus (SARS-CoV-2) in Human Nasopharyngeal Swab Specimens Using Field-Effect Transistor-Based Biosensor. *ACS nano*. 14, 4, 5135–5142, https://doi.org/10.1021/acsnano.0c02823