Virus detection sensor using field effect transistor

Technology / Virus detection sensor using field effect transistor

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CEVI 신종바이러스융합연구단 Center for Convergent Research of Emerging Virus Infection

Patent title Virus detection sensor using field effect transistor

Inventor Korea Basic Science Institute / Seo Kiwan

Patent application No. -

Authority status Not filed

Technicality

Technology overview

- Provided is a platform technology in which a bioprobe (antibody) can be attached through surface modification by using a sensor channel layer based on nanomaterials and a detection change in electrical conductivity of the sensor channel layer can be measured by specific binding of a substance to be detected (antigen) bound to the bioprobe.
- If the size of detection equipment is reduced on the basis of the platform technology, it is expected that infectious diseases can be diagnosed early with high-sensitive real-time detection.

Development background and problem to be solved

- Corona virus infectious disease 2019 (COVID-19) is a respiratory infectious disease newly emerged by severe acute respiratory syndrome Corona virus 2 (SARS-CoV-2). As the rate of human infection is rapidly increasing, there is a need for a biosensor technology which can check whether or not a person is infected with the Corona 19 virus and can be carried out in the medical field.

Excellence and discrimination of technology

▶ Excellence of technology

- An FET biosensor is a representative technology which accelerates NT convergence following BT and IT convergence.
- Graphene, which can be mass-produced, is used as a sensing material so that there is a high possibility of commercialization.
- A high-sensitive real-time detection system can be built when the size of detection equipment is reduced in the future.

▶ Discrimination of technology

- Existing procedures performed for diagnosis and screening of infectious diseases in hospitals are very complex, and the burden of medical expenses is high due to the use of expensive measuring equipment.
- Unlike a cancer diagnosis, a highly sensitive platform technology capable of rapidly diagnosing diseases at an early stage of infection is needed for infectious disease screening.

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Implementation method

- Through a simple pre-processing process, a patient's sample is injected into a biosensor, and infection is confirmed in real time.
- A graphene-based field-effect transistor (FET) biosensor uses an antigen-antibody reaction against a virus. When a cultured virus or a sample collected from a COVID-19 patient is injected into an antibody that is fixed on graphene of the sensor and specifically binds to the Corona 19 virus, the virus binds to an antibody, and the sensor which recognizes this binding reaction immediately triggers an electrical signal change to notify the presence or absence of a virus.

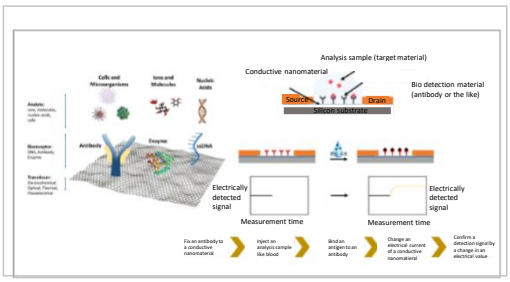

Figure 1 Schematic diagram and measurement principle of FET biosensor

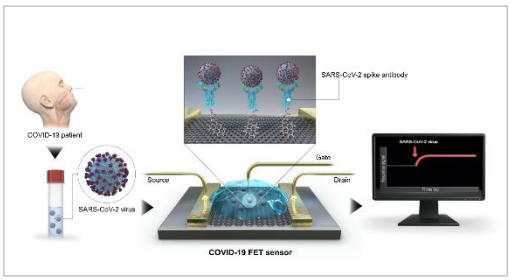

Figure 2 Conceptual diagram of real-time confirmation of COVID-19 infection

Degree of technology completion (TRL)

Degree of technology completion: TRL3 (technology concept verification)

TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Technical principle presentation	Technology concept setting	Technology concept verification	Lab Scale prototype development	Implementation environment application experiment	Full Scale prototype development	Quasi-commercial product development	Commercial product development	Commercial product implementation

Utilization

Utilization field and applied product

Utilization field

· Virus diagnosis

Figure 1 Virus detection and diagnosis
<Data: Korea Basic Science Institute>

Applied product

· Virus field diagnosis

Figure 2 Virus field diagnosis
<Data: Z Biotech Inc.>

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Technology trend

- The importance of an early diagnosis increases due to the emergence of new diseases, the COVID-19 pandemic, and an aging population. Thus, a medical paradigm shifts from treatment to rapid diagnosis and prevention, thus and the in vitro diagnostic device industry-related market has grown rapidly.
- With the recent emergence of new infectious diseases related to coronavirus such as MERS and COVID-19, R&D and application activities for on-site diagnostic technologies are expected to increase.
- Biosensors, a core technology for on-site diagnostic devices, are being developed on the basis of various technologies. With the recent development of synthetic antibody technologies, immunochemical diagnosis technologies which can be used for an analysis of low molecular weight compounds, carbohydrates, lipids, and the like and an analysis of various microorganisms have been applied. Various digital immunodiagnostic technologies have been developed to overcome the measurement limitations due to the low sensitivity of general immunodiagnostic technologies.
- An immunochemical diagnosis system includes an antigen/antibody search and processing device, the development of related software, and data processing technologies, and diagnoses diseases by detecting antigens/antibodies produced by various diseases through enzyme immunoassay, fluorescent immunochemical assay, spin immunochemical assay, or the like.

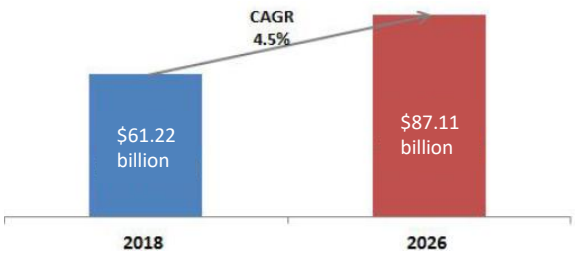
Family patent status

Application nation	Application No. (Application date) / Registration No.	Title of the invention
KOR	- (to be filed)	Virus detection sensor using field effect transistor

Market prospect

Target market size and prospect

- The global in vitro diagnostic market is expected to grow at a CAGR of 4.5% from USD 61.22 billion in 2018 to USD 87.11 billion in 2026 due to the adoption of new technologies for rapid disease diagnoses.
- The global molecular diagnostic market is expected to grow by 4.7% from 2015 to 2023.
- The immunochemical diagnostic market size in ROK is expected to grow at a CAGR of 10.7% from KRW 340.7 billion in 2018 to KRW 558.9 billion in 2023.



Technology classification (unit: million dollars)	2015	2016	2017	2018	2023	CAGR(%)
Molecular diagnosis	15,102.4	15,862.6	16,656.8	17,507.6	22,034.5	4.7
Immunochemistry	10,096.3	10,591.6	11,119.4	11,684.8	14,869.6	4.7
Field diagnosis (POCT)	6,912.2	7,313.0	7,744.4	8,209.1	10,777.7	5.6
Blood diagnosis	5,292.1	5,547.6	5,820.8	6,113.4	7,664.2	4.6
Clinical microbiological diagnosis	4,212.1	4,405.2	4,611.4	4,831.9	5,987.6	4.4
Organizational diagnosis	4,212.1	4,412.5	4,626.7	4,856.0	6,067.5	4.6
Self blood glucose measurement	3,240.1	3,419.2	3,611.7	3,818.6	4,949.8	5.3

Table **Global market trends related to in vitro diagnostic market [million dollars]**

<Data: In Vitro Diagnostics/IVD Market, MARKETSANDMARKETS, 2018>

Technology transfer query

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Technology transfer process