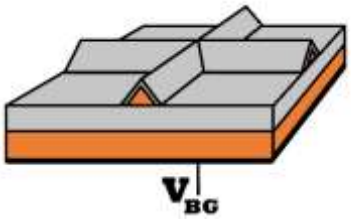
CMOS biosensors

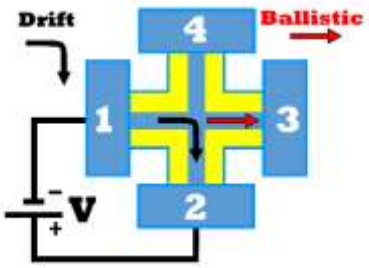
Sensitive sensors for real-time measuring

Invention

Small, compact biosensors faster and up to 10 times more sensitive than conventional sensors can be created affordably in a CMOS-compatible manufacturing process. The sensor measures miniscule voltage potentials using a field-effect transistor and crossed nanowire structures. The field-effect transistor is surrounded by an impermeable border. Additionally, two crossed Si nanowires made of semiconducting materials, each with a source and drain contact with a means to apply voltage between each source and drain contact, are connected. The nanowires are insulated from the sample material by a dielectric layer along their surface. This layer has at least one attachment point (e.g., for functionalization layers) that can trap charge carriers on the nanowires or, conversely, release them. The two nanowires each have a triangular cross-section and are supplied with voltage from the substrate, allowing for the manufacture of a highly sensitive probe/biosensor when functionalization layers for the appropriate molecule are applied to the nanowires.



Crossed Si nanowire structures with triangular cross-section



Nanowire activation

Commercial Opportunities

This new method allows the manufacture of biosensors that are faster and up to 10 times more sensitive. The affordable, CMOS-compatible manufacturing process and the small design can make possible, e.g., biosignal monitoring for molecules such as C-reactive protein (CRP), cardiac troponin I (cTnI) or electrogenic cells, or peptides such as amyloid-beta.

Current Status

The underlying technology was filed with the German Patent and Trademark Office under DE102013018850A1 on 10/15/2014 and a patent has been issued. Patents have also been issued in the following countries: CN, JP, US, EP (DE, BE, FR, SE, GB, CH, AT, LI, NL).

Current advancements in the technology were filed in Germany under DE102016010764A1 on 09/08/2016. Patent applications for these advancements have also been filed internationally (CN, JP, US, EP). An existing prototype is proof of concept for the technology. On behalf of Forschungszentrum Jülich, we are offering interested companies the opportunity to license and continue to develop this technology.

Relevant Publications

Amyloid-beta peptide detection via aptamer-functionalized nanowire sensors exploiting single-trap phenomena. Y. Kutovyi, Biosensors and bioelectronics. 154, 112053-1-8 (2020). https://doi.org/10.1016/j.bios.2020.112053

Characteristic Frequencies and Times, Signal-to-Noise Ratio and Light Illumination Studies in Nanowire FET Biosensors. S. Vitusevich. Invited paper, IEEE Int.l Ukr. Symposium on Physics and Engineering of Microwaves, Millimeter and Submillimeter Waves (MSMW 2020), Kharkiv, Ukraine, September 21-23, 580-585 (2020).
https://www.doi.org/10.1109/UkrMW49653.2020.9252698

An invention of Forschungszentrum Jülich.

Competitive Advantages

- Highly sensitive biosensors
- CMOS-compatible
- Small design
- Allow real-time measuring
- Suitable for low-cost measuring applications

Technology Readiness Level

1 2 3 4 5 6 7 8 9

Technology validated in lab

Industries

- Metrology
- Electronics
- Sensor technology

Ref. No.

F-0199

Contact

Martin van Ackeren
E-Mail: ma@provendis.info
Phone: +49(0)208-94105-34

PROvendis GmbH
Schlossstraße 11-15
45468 Muelheim an der Ruhr
Germany
www.provendis.info