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EMERGING TECHNOLOGY SNAPSHOT

CANADIAN BIOSENSORS OVERVIEW

Biosensors detect one or more biological components in an environment (e.g., a room, human body, liquid, vehicle, etc.). There are multiple types of biosensors including environmental, chemical, electrochemical, optical, and microelectromechanical (MEMS) systems, among others. Each biosensor identifies and converts a biological reaction into a signal so as to interpret it. Biosensors usually combine a biological component (e.g., an enzyme) with a physiochemical detector, but current research is focusing heavily on new or alternative approaches.

ENABLING SCIENCE AND TECHNOLOGY

Infectious diseases/Pathogens

Deals in the Canadian biosensors market are mostly health-oriented. The COVID-19 pandemic brought a huge increase in investment size to this sector, mostly in pharmaceuticals & biotechnologies and agriculture. Eleven Canadian companies received venture capital investment in the field since 2015. Examples of innovations to detect infectious diseases or pathogens in the environment, food chain or human body include: non-polar molecule biosensors, optical thermal biosensors and graphene field effect transistor biosensors.

Chemicals/Pollution

Chemical biosensors measure and detect chemical content in an analyte (the chemical substance being observed), converting a chemical or physical property of that analyte into a measurable signal. Sixteen Canadian companies received VC investment in this field since 2015. BCC estimates that the value of the Canadian environmental sensing market was $800 million (US) in 2020 (4% of the global market). Particulate detection sensors for air quality monitoring are the main market.

Plasmon resonance

Plasmonic sensors have shown unique capabilities in performing sensitive and accurate analyte measurements. Plasmonic sensors enhanced by quantum technology were identified as a key opportunity in the field by Frost & Sullivan.

Artificial intelligence (AI)

Advancements in artificial intelligence (AI) and edge computing have given rise to new methods to analyze and derive insights from sensor data often merged with other datasets. These sensors are known as AI-defined sensing, which includes but are not limited to biosensing. Over the last 5 years, 20% of Canadian biosensor VC deals were AI-related, with these accounting for 50% of the deal value.

"Recent advances in stretchable materials, microfluidics, optical/electrochemical sensors, image processing and analysis, near-field communication and wireless power supply, microneedles, as well as big data and cloud computing provide a robust foundation for wearable biosensing, especially in the field of microfluidics for sweat and for sweat and interstitial fluid biosensing."

Ye, S et al. "Recent Progress in Wearable Biosensors: From Healthcare Monitoring to Sports Analytics" in *Biosensors*, 2020, 10 (12), 205.

SIGNALS

Academic

The University of Waterloo is the second-biggest VC investor, having invested in 8 Canadian companies involved in the development of healthcare-sensing applications. The university's Nano and Micro Systems Lab is involved in nano-biosensors and MEMS research.

Government

The Government of Canada is the top Canadian VC investor, accounting for 30% of total deal value $305 million (US) mainly through grants. MaRS Innovation, Ontario Centres of Excellence, Business Development Bank of Canada, and the Ontario Bioscience Innovation Organization were also among the top investors.

Defence

Since 2015, 5 Canadian biosensing companies involved in developing sensing devices for defence received VC funding. Most are also developing electric-sensing technologies.

Corporate

In the last 5 years, 122 Canadian biosensing companies received VC funding. About 60% of these companies are now generating revenues. Top Canadian players include: AbCellar (Biotechnologies), Semios (Agriculture), Imagia (Healthcare), Aspect Biosystems (Biotechnologies), Nicoya Lifesciences (Electronics) and SomaDetect (Electronics).

"Small companies make up the bulk of the sensor manufacturing business. Most companies pursue a focused strategy, but competitive and technological pressures are leading to consolidation and increasing concentration."

Sensors: Technologies and Global Markets. BCC Research. December 2020.

IMPACT

Social

The privacy of personal biological data is a key issue. As biosensors and other technologies use and store biological data, new policies and regulations will be needed to protect the public.

Research

Key biosensor research challenges include: long-term and stable high sensitivity, fast readout times, limited biomolecule life span, along with miniaturization, power-supply requirements and cost effectiveness.

Economic

The value of the global biosensor market is forecast to reach $34 billion (US) by 2027 according to Emergen Research (Sept 2020). The healthcare sector accounts for 62% of this market in 2019.

Environmental

Growing and more stringent climate change-related regulations are key market enablers for environmental and chemical biosensors. Emission monitoring and reporting is expected to drive innovation in this sector.

Defence

Biodefence is a key application area. Military use of biosensors includes remote detection of explosives, chemicals, biological agents, drugs and biomolecules (i.e. bacteria).

"The drastic modification of [nanomaterial biosensors] unique physical and chemical properties in the target analyte's presence allows the ultrasensitive and multiplexed detection of different biomolecules, such as disease biomarkers, enzymes, proteins, nucleic acids, extracellular vesicles, cancer cells, and pathogens […], addressing novel strategies to resolve real clinical issues."

Frontiers: Nanomaterials for Bioimaging, Sensing Devices and Theragnostic Application website. https://www.frontiersin.org/research-topics/18791/nanomaterials-for-bioimaging-sensing-devices-and-theragnostic-applications

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