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Editorial: Thought leaders in sensor research: volume 2

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Editorial on the Research Topic
Thought leaders in sensor research: volume 2

The *Frontiers in Sensors* "Thought Leaders in Sensor Research" article Research Topic represent a new type of resource, distinct from conventional research papers describing laboratory outputs or review papers summarising published literature. The initiative's vision is to gather insights from established and emerging thought leaders in sensor science and engineering—covering fundamental research that could spark revolutionary breakthroughs and addressing challenges that must be overcome for sensing technologies to fulfil their potential to improve our world. Over time, the Research Topic will grow into a global resource, stimulating debate, identifying key challenges, and influencing investment policies for agencies and governments. This vision is already having impact: the five papers in Volume 1 have received 19,357 total views and 3,793 downloads since the first two were published in September 2021. The addition of five high-quality papers from top international authors in Volume 2 will further enhance the Research Topic's impact and reputation.

In their article "*Chemical nanosensor arrays for human breath-based diagnostics: Perspective and a promising result for COVID-19 detection*", Ricco et al. report on advances in the use of application specific arrays of sensors that seek to balance analyte selectivity with reversibility, in contrast to the use of single sensors that require strong and therefore irreversible binding to achieve very specific analyte recognition. They demonstrate the feasibility of the approach through a success rate of 92% in a trial involving 63 volunteers for the detection of COVID-19 in human breath.

Nagata and Sode discuss the importance of biocatalytic biological recognition elements for opening ways to continuously monitor biomarkers and drugs in their contribution "*In-vivo continuous monitoring with biosensors based on engineered biological recognition elements: opportunities and challenges*". They highlight the success of the biocatalyst glucose oxidase as the foundation of recent advances in continuous *in-vivo* monitoring of glucose and its profound impact on the lives of millions of diabetics world-wide. However, this success is based on the unique nature of the application, as glucose is present at high concentration in blood (2–40 mM), and the enzyme is unusually stable and robust. Continuous monitoring of biomarkers other than glucose will require new types of biorecognition and transduction incorporating innovative amplification techniques to enable reliable continuous monitoring of analytes at μM-nM concentrations. They point to the already dramatic impact of AI on the biosynthesis of lead structures that should exhibit the required combination of selectivity, stability, and catalytic amplification for specific target analytes.

Avenues for future advancements beyond the current performance limitations of distributed optical fiber sensors is the focus of the paper "*Distributed optical fiber sensors: what is known and what is to come*" by Thévenaz. The strong connection between highly distributed optical fiber sensors and big data systems is highlighted as a key driver for the technology as it enables important physical parameters to be continuously measured at multiple points over increasingly large scales (tens of kilometers). Advances in performance will emerge from a combination of new materials and fibre configurations such as hollow core antiresonant fibers, coupled with improvements in signal processing algorithms and AI-driven analytics. These advances have the potential to overcome the current practical limits of distributed fiber sensing, unlocking new opportunities for improving infrastructure reliability, early detection of equipment or infrastructure malfunction leading to enhanced operational efficiency, improved use of resources and a safer environment.

In his contribution "*"Please learn from my mistakes": the acute need for an entrepreneurial mindset in academic biosensor research*", Heikenfeld offers valuable advice to academic researchers seeking to become involved in technology innovation associated with their research outputs. This article provides valuable insights based on the author's personal experience in which he highlights the critical need for a more structured development of an entrepreneurial mindset for academic researchers. Although the article focuses on sweat-based biosensing, the lessons learned and articulated with rare honesty offer valuable insights to anyone involved in sensor research, and technology-based innovation generally. Those who have experience in the process will recognise his descriptions of the 'peak of inflated expectations' which is followed by the "trough of disillusionment". However, in the final section 'The slope of enlightenment', he provides valuable advice that he wishes he had utilized when he started working in biosensors in 2012.

The importance of *in-situ* autonomous sensors for distributed environmental sensing is the focus of a paper entitled "*Understanding and mitigating global change with aquatic sensors: current challenges and future prospects*" by Diamond et al.. The paper initially sets the scene by summarising the major causes of global change arising from human activities such as including habitat destruction, invasive species in non-native ecosystems, overexploitation, pollution, and global climate change. They focus on the urgent need for inexpensive, robust, devices with analytically appropriate performance characteristics, that can function reliably between service intervals of at least several months in an (often hostile) aquatic environment. While this is currently possible with transducers monitoring physical characteristics like light, temperature and position, it is still a major challenge for devices tracking chemical (e.g., nutrients, heavy metals) and particularly biological parameters of interest (e.g., *E. coli* or *enterococci*).

Although only launched in 2023, this topic is already generating very significant interest in the sensor research community, with >7,000 topic views and >1,300 article downloads. Frontiers in Sensors looks forward to the next article Research Topic to continue to grow this valuable resource for the benefit of our readers.

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