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Editorial

Optical Chemosensors and Biosensors

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1. Introduction

The field of chemo- and biosensors, ranging from biomedical/clinical applications to environmental applications and food analyses, has been growing in the last two decades. In fact, in all these fields, there is a continuously increasing demand for rapid responses, quality control, usable devices, and low-cost analyses. The growth is likely to be driven by continuous technological advancements in sensor systems, which lead to the development of devices characterized by ever higher performances capable of satisfying the increasingly strong requests in terms of sensitivity and detection limit in the different application sectors. All these features could lead to an improved, healthy life, ranging from a more reliable and controlled quality of food and environment to a faster and more specific diagnosis [1–4].

The optical detection methods applied in chemo- and biosensors make use of both label-based or label-free techniques. The former ones make use, for example, of fluorescent [4,5] or chemiluminescent-based detection systems [6,7], while the latter are generally based on the direct optical detection of the refractive index changes induced by chemical/biochemical reactions [8–10].

The proposed contributions in this issue focus on bacterium, oxygen, metal or metal ion, and gas sensing devices for food/environmental applications, as well as on glucose and sepsis biomarker detection for medical applications.

2. The Special Issue

This special issue is focused on chemo- and biosensors based on optical detection methods, with both label-based and label-free techniques. The described applications in the nine full articles range from the theoretical and experimental demonstration of polar-time evolutions of chemiluminescence emission thanks to the anisotropic emission of light at the solid–liquid interface; to environmental and food applications starting from gas sensing and proceeding to nitrogen, phosphorus and potassium, metal ions, microorganisms, and oxygen sensors for food packaging. Moreover, two papers for medical applications are included for glucose detection in urine samples and for the detection of sepsis biomarkers in serum.

Berneschi et al. [11] described a method for the real-time monitoring of chemiluminescence (CL) emission anisotropy at the liquid–solid interface based on a radial array of optical fibers. The spatial distribution of a CL emission from an enzyme reaction and its time evolution were investigated, and the study revealed that the anisotropic CL emission occurs when the enzymes catalyzing the CL reaction are in close proximity to the liquid–solid interface.

A contactless optical sensor for NO_2 is demonstrated by Faglia et al. [12], who developed a system based on the photoluminescence properties of a 1D/2D hybrid structure realized by depositing ZnO nanorods through magnetron sputtering on exfoliated MoS_2.

A Schiff base ligand was investigated via UV–Vis spectroscopy in the work of Alorabi et al. [13]. The high selectivity and sensitivity of the ligand, bearing azomethine (>C=N-) and thiol (-SH) moieties capable of coordinating to metal ions (i.e., Cr^{3+}, Fe^{2+}, Fe^{3+}, Hg^{2+}), was demonstrated, making it an attractive candidate to be used in colorimetric chemosensors for the detection of heavy metal ions.

Another sensor for metal ions is proposed by Helal [14], who employs a fluorescein-allyloxy benzene conjugate. In this work, UV–Vis and fluorescence spectroscopy are used for the sequential detection of palladium and chromium oxyanions in a mixed aqueous solution providing a limit of detection (LOD) of 49 ppb for Pd^{2+}, and 127 and 259 ppb for the two chromate ions CrO_4^{2-} and $Cr_2O_7^{2-}$, respectively.

In the paper of Monteiro-Silva et al. [15], UV–Vis spectroscopy was used for the direct quantification of nitrogen, phosphorus and potassium (N, P, K) in nutrient-containing fertilizer solutions. This was achieved by determining the spectral interference between N, P, and K in fertilizer solutions and by employing an innovative self-learning artificial intelligence algorithm.

A sensor based on the surface plasmon resonance technique and molecularly imprinted nanoparticles was reported by Saylan and coworkers for the direct and label-free detection of *Enterococcus faecalis* in water samples [16]. In this approach, *E. faecalis* surface protein is imprinted on the nanoparticles to create artificial recognition sites for bacteria detection. The reported LOD was estimated to be 3.4×10^4 cfu/mL.

A comparative study of five differently stable types of phosphorescence-based oxygen sensors for food packaging applications was conducted by Kelly at al. [17]. When exposed to a panel of standard food simulants and upon direct contact with raw meat and cheese samples packaged under a modified atmosphere, the sensors based on ungrafted polypropylene material and impregnated with phosphorescent dye by the soaking method were shown to provide the best implementation in terms of stability and performance.

Wang et al. [18] reported a label-free colorimetric method for the direct determination of urine glucose using a smartphone ambient light sensor as a data reader. This method takes advantage of a horseradish peroxidase—hydrogen peroxide—3,3′,5,5′-tetramethylbenzidine (HRP-H_2O_2-TMB) coloring system that allows the determination of glucose present in urine samples based on the fading of the color solution. Good repeatability, sensitivity and accuracy makes this approach potentially applicable for the point-of-care monitoring of urine glucose.

A fluorescence-based integrated optical measurement system for the simultaneous detection of C-reactive protein (CRP) and neopterin (NP) sepsis biomarkers is described by Giannetti et al. [19]. A limit of detection as low as 10 and 2.1 μg/L was achieved for CRP and NP in commercially available human serum, respectively. The portable point-of-care testing system was also evaluated for the detection of CRP and NP in serum samples collected from septic patients.

In conclusion, this special issue explores new insights on the label-based and label-free methodologies for sensing applications for an improved, healthy life, ranging from a more reliable and controlled quality of food and environment to a faster and more specific diagnosis.

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Conflicts of Interest: The authors declare no conflict of interest.

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