



Editorial

Thin Film-Based Sensors

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1. Introduction

An increasing number of fields in everyday life require the development and application of ever more modern and efficient chemical sensors and biosensors, namely to be integrated in intelligent control system networks. The applications extend to all fields, from drug detection to clinical diagnosis, from the control of industrial quality and safety, from combating bioterrorism to health care and from environmental monitoring to food quality control. The general way to create sensing units is by using a hierarchical assembly of nanoscale building blocks as thin film sensing structures which are able to adsorb or interact in some way with the molecules to be detected. Different transducing methods have been addressed, such as potentiometry, amperometry, cyclic voltammetry, and impedance spectroscopy, and also other methods such as microcantilevers, surface acoustic waves, surface plasmon resonance, and fiber optic-based sensor devices. The original purpose of this Special Issue on thin film-based sensor devices is to provide a survey of the state-of-the-art for both organic and inorganic thin film sensor-based devices, covering a wide range of experimental techniques for the attainment of molecular layers, such as Langmuir–Blodgett, self-assembly, layer-by-layer, molecularly imprinted polymers, sol-gel, casting, spin-coating, vacuum evaporation, plasma-assisted deposition, electron beam deposition, chemical vapor deposition or molecular beam epitaxy and inkjet coating and patterning. The proposed contributions in this issue focus on cover gas sensing devices, pH sensors closely related to water quality, and sensors dedicated to food quality control and monitoring.

2. The Special Issue

This special issue focuses in thin film-based sensor devices for applications ranging from the detection of molecules in gaseous and liquid samples to food quality control. The six full articles and the review presented here include three main type of sensors, namely those for the detection of molecules in gas, pH sensors and sensors for monitoring bacteriophage and mycotoxin contamination, clearly offering a vision of the latest developments in this field and pointing out future perspectives and new trends in this area of knowledge.

From the main results and conclusions associated with the contributed papers with respect to gas sensors it should be emphasized that Sarfraz et al. [1] used, a low-cost, flexible and environment-friendly material: a paper support coated with nanostructured latex. The paper support was covered with gold electrodes together with a film of copper acetate. This device was seen to be able to detect qualitatively and quantitatively toxic hydrogen sulfide (H₂S) gas up to concentrations of 1.5 ppm by electro-optical measurements. An interesting approach to detecting ammonia was proposed by Banimuslem and Kadem [2], based on spin-coated thin films of fluorinated chromium phthalocyanine. These films, when exposed to ammonia gas, show an increase of electrical resistance towards the existence of ammonia molecules. These devices demonstrate an ammonia gas-sensing activity in a concentration range of 40–100 ppm. Moreover, the response and recovery time of the sensor devices were found to be 10 and 13 s, respectively. Last but not least, the valuable contribution of Myasoedova

et al. should be noted [3], in which SiO₂ZrO₂ thin films were used to detect high concentrations of NO₂ gas at a low operating temperature (25 °C). These films were prepared by the sol-gel technique, and their resistance was shown to be dependent on the amount of NO₂ impurities in the air. This device works in the concentration range of 40 to 1060 ppm and presents both high stability and reproducibility.

New advances in pH sensors are demonstrated by the contribution of Hammarling et al. [4], which took advantage of the ability of acryl-terminated oligo(β -amino esters) (AOBAE) to be coated on fibers and also printed electronics without solvents to develop pH-responsive coatings that can be applied in pH sensors. Progress is also shown in the new prototype of a broad-range hydrogel-based pH sensor presented in this issue [5]. This prototype was prepared in a Mylar flexible support with gold interdigitated electrodes in which hydrogel films are deposited. Presented results for this device demonstrate an ability to measure pH in the 2.94 to 11.80 range with good repeatability in regard to the cycling of the sensor with different pH values and multiple measurements from dry states.

Two interesting and profitable examples of how thin films can be used in food control applications are demonstrated in this issue. In the article by Rosati et al. [6], a thin film produced by a consumer-use inkjet printer with commercial AgNP ink on flexible supports, such as office paper, polyethylene (PET), and photo paper, were used to monitor *Lactococcus lactis* cultures and bacteriophage infection via impedance spectroscopy. This method was shown to provide a response time less than half the time of standard microbiological methods, and it did not require specialized personnel to operate. The review presented by Santos et al. [7] should also be highlighted, a consistent contribution for this issue, which clearly and thoroughly summarizes the applications and challenges of thin film sensor devices for the detection of mycotoxins in food matrices.

Finally, one expects that the contributions published in this Special Issue will be of great interest to researchers, students and engineers and help to keep these readers up-to-date on gas sensors, pH sensors and food quality control sensors.

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