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Guest editorial: Chemical sensors for pollution monitoring and control

There is a continuing need for the development of rugged and reliable chemical sensors capable of making measurements in harsh industrial environments, as well as for public health and security. The use of chemical sensors covers a wide range of industries such as steelmaking, heat treating, metal casting, glass, ceramic, pulp and paper, automotive, aerospace, utility and power. Emission monitoring sensors for these applications include those for CO, NO_x (NO and NO_2) O_2, CO_2, hydrocarbons (HCs) and volatile organic compounds (VOCs). In automotive engines, for example, the application of sensor and measurement technology has resulted in improved energy efficiency with reduced emissions. Chemical sensors are also being applied in domestic appliances and air quality monitoring. Lately, chemical sensors are attracting attention for applications such as early detection of smoke/fire as well as hazardous chemical agents to provide safety and security in public places and mass transportation systems. Despite the continuing demand, for commercial success, major advances in these sensors are required in terms of simple structure, lower cost, selectivity, durability and reliability. What makes this area exciting for future R&D is that the solution to engineering and technological problems is closely linked with the fundamental knowledge and understanding yet to be uncovered.

The Editorial Board of Journal of Materials Science commissioned this special section and I was invited by Professor Helen Chan (Lehigh University) to act as the editor. I invited Professor Chong Park (KAIST, Korea) to join me as the co-editor. After a few iterations, we decided to name this special section, "Chemical Sensors for Pollution Monitoring and Control". We are happy to bring to the reader this collection of fourteen papers, selected through peer review, from a distinguished group of international authors. The papers cover a range of topics, as wide as possible within the selected theme.

The papers are arranged following a simple logical order. The first paper introduces the theme in a general manner and gives an overview of some of the recent developments in combustion gas sensors (both resistive and electrochemical types) at the sensor center (CISM) at Ohio State University. This is followed by a group of three review papers dealing with O_2 sensing. The first paper by Lee focuses exclusively on automotive applications, detailing the evolution of the YSZ-based electrochemical sensor. The second paper by Fergus deals with both the YSZ-based and TiO_2-based resistive sensors, particularly addressing the effect of doping and defect association. The third paper by Ramamoorthy *et al*. focuses on general aspects of materials, principles, designs and applications of O_2 sensors, including those based on the luminescence quenching technique. The electrochemical sensor theme is continued with a CO_2 sensor by Obata *et al*., a CO_2 micro-sensor by Ward *et al*., an NO_2 sensor by Kale *et al*. and an SO_2 sensor by Shimizu *et al*. This theme is concluded with a paper by Liu *et al*. that integrates a perm-selective membrane.

The next group of four papers deals with the resistive/semiconductive type sensor. While three of these papers deal with SnO_2-based sensors (Lee *et al*., Ahmad *et al*. and Pijolat *et al*.), the fourth focuses on MoO_3- and WO_3-based sensors (Gouma *et al*.). The paper by Lee *et al*. addresses CO sensing at room temperature that would be of interest for domestic applications, as well as air quality monitoring. The paper by Pijolat *et al*. presents an overview of their work, including real-time test data on air quality monitoring in two cities in France.

Finally, this special section is concluded with a capacitive type H_2 sensor by Zhu *et al*. This review paper focuses on recent advances in hydrogen-sensitive ferroelectric thin film capacitors and related mechanisms. Though this paper does not easily mesh with the predominant types of sensors mentioned above, it attracts our attention to a future need for hydrogen sensing in automobiles. As we are aware, hydrogen is a promising alternative energy source for the next generation of automobile engines that meet the concern of energy shortage and global environmental pollution.

We are grateful to the authors for their contributions and cooperation in adhering to the timetable. The reviewers are particularly acknowledged for their time in critiquing these papers. Through their hard work and dedication, we have ensured the quality of these papers as best as possible. Finally, we acknowledge the Editorial Office at Kluwer, and Angela DePina in particular, for making this a reality.

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