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Editorial

State-of-the-Art Laser Gas Sensing Technologies

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1. Introduction

The increasing desire to detect and monitor in different fields [1–4] such as in environmental air, life sciences, medical diagnostics, and planetary exploration demand the development of innovative sensing systems. Laser spectroscopy-based techniques have the advantages of high sensitivity, non-invasiveness and in situ, real-time observation [5–7]. Because of these merits, we introduced state-of-the-art laser gas sensing technologies in this Special Issue. A total of 30 papers was received for consideration of publication. Among them, six manuscripts were rejected by the editor in the initial check process without peer review. The remaining manuscripts were all reviewed by at least two reputed reviewers in related fields from the USA, France, Italy, Germany, Russia, and so on. Finally, 16 manuscripts were accepted for publication in *Applied Sciences-Basel*. We would like to thank all of these numerous reviewers for their effort.

2. Main Content of the Special Issue

The recent advance in laser sources and detectors has opened up new opportunities for laser spectroscopy-based sensing and detecting techniques. Furthermore, the new technique has helped to promote its applications. Therefore, in this Special Issue, papers focus on novel laser sources and advanced sensing methods and their applications.

With respect to the laser sources aspect, three papers are concerned. All of them are related to mid-infrared lasers, which are beneficial to laser spectroscopy methods due to the strongest fundamental absorption bands of gas molecules located in this wavelength region. The first paper, authored by J. Zhao, P. Cheng, F. Xu, X. Zhou, J. Tang, Y. Liu, and G. Wang presents a continuous-wave single-frequency singly-resonant mid-infrared optical parametric oscillator (OPO) with emission wavelength at 3.68 μm [8]. The output power of more than 1 W indicated the high output level. Therefore, such a source is especially beneficial to power related laser-based gas detection techniques, such as photoacoustic and photothermal spectroscopy [9,10]. The second paper submitted by W. Wang, L. Li, H. Zhang, J. Qin, Y. Lu, C. Xu, S. Li, Y. Shen, W. Yang, Y. Yang, and X. Yu reports a pulsed Tm,Ho:$LuVO_4$ solid-state laser with a repetition rate of 54.5 kHz and an output power of 1034 mW. The emission wavelength shifted from 2075.02 nm to 2057.03 nm when the operation mode was switched from continuous wave to Q-switched [11]. The last paper in this section, authored by D. Yu, Y. He, K. Zhang, Q. Pan, F. Chen, and L. Guo, is about a compact thermal control system for a tunable mid-infrared solid-state laser, which could be used to improve environmental temperature adaptability and solve heat dissipation problems for mid-infrared lasers [12].

In the gas sensing aspect of this Special Issue, Y. F. Ma presents a review paper about recent advances in the quartz tuning fork based on photoacoustic detection [13], while K. Krzempek summarizes the

research progress in gas sensing by photothermal spectroscopy [14]. Both techniques are based on the photoacoustic effect. Another review paper concerned with femtosecond laser-induced emission spectroscopy and its application in combustion and flow field diagnostics was presented by B. Li, D. Zhang, J. Liu, Y. Tian, Q. Gao, and Z. Li [15]. The last three review papers, authored by Z. Du, F. Wang, and X. Chao, respectively, mainly focus on direct laser absorption spectroscopy, especially in the mid-infrared region [16–18]. All the above review papers presented a full discussion with regard to the related technical field of gas sensing. The remaining papers report on the technical research of gas detection based on direct laser absorption spectroscopy [19–25]. The target analytes were acetylene (C_2H_2) [19], methane (CH_4) [20], oxygen (O_2) [21], and $^{13}CO_2/^{12}CO_2$ isotopic ratio [22]. The corresponding sensors were used for the monitoring of power plant exhausts [23] and vision imaging [24].

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