10th International Conference and Exhibition on
LASERS, OPTICS & PHOTONICS
November 26-28, 2018 | Los Angeles, USA

Tailored algorithm for sensitivity enhancement of gas concentration sensors based on TLAS

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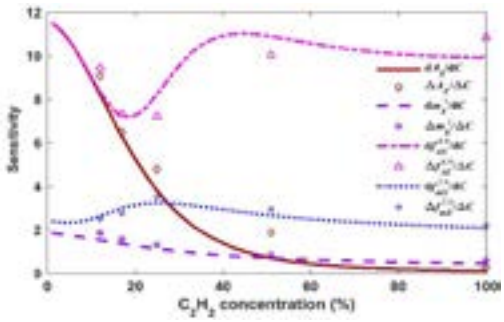
Gas sensors based on Tunable Laser Absorption Spectroscopy (TLAS) are widely used due to their high sensitivity and selectivity. Moreover, there currently exists a wide range of laser options to implement this application. Depending on the sensor system design some authors have been capable to enhance different technical characteristics such as the minimum detectable concentration and the sensitivity over the certain dynamic range. In this work, a novel tailored algorithm to enhance the overall sensitivity of gas concentration sensors based on the Direct Absorption Tunable Laser Absorption Spectroscopy (DA-ATLAS) method is presented. By using this algorithm, the sensor sensitivity can be custom-designed to be quasi-constant over a much larger dynamic range compared with that obtained by typical methods based on a single statistics feature of the sensor signal output (peak amplitude, area under the curve, mean or Root-Mean-Square (RMS)). Moreover, based on the proposed algorithm, it is shown that it is possible to establish a quasi-linear relationship between a tailored statistics feature and the concentration within the wider dynamic range. This consequently allowed us to get a high and quasi-constant sensitivity within this concentration range. Furthermore, this algorithm can be applied to currently-designed sensors since it is only necessary to change the way in which the sensor signal output is processed. This new algorithm is based on the combination of different statistical features of the sensor signal output instead to consider just one statistics feature (area, peak amplitude, RMS). This type of statistical analysis is commonly used in digital image processing for texture measurements. Finally, in order to support the general performance of the algorithm, a basic C_2H_2 sensor based on DA-ATLAS was implemented and its experimental measurements are in agreement with the simulated results provided by our algorithm.



Simulated and measured sensor sensitivity versus the gas concentration. Here the sensitivity was calculated considering a typical single statistic feature (peak amplitude (A) and the mean (m1)) and considering some of our tailored functions based on the combination of two statistics features (fm and fA).

Biography

Everardo Vargas Rodriguez completed an MSc in instrumentation at the Universidad de Guanajuato, Mexico. Afterward, he received a PhD in Optoelectronics at the University of Southampton in 2007. He joined the University of Guanajuato in Mexico since 2007 and later he was appointed as a Director of the Department for Multidisciplinary Studies were he served from 2008-2016. Currently, he is an Academic Editor of the Journal of Sensors and he is interested in optoelectronics sensors and fiber lasers.

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