Surface-functionalized multichannel nanosensors and machine learning analysis for improved sensitivity and selectivity in gas sensing applications

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Abstract. Breath analysis is an emerging technique in the field of diagnostics. The presence of thousands of gases and volatile organic compounds, many of them at ppb levels, require the development of ultrasensitive and selective detection approaches, which are issues still trying to be addressed by the scientific community. Here, we describe two approaches that provide a substantial contribution to the development of gas sensors. The first one is based on modifications on the used hardware, namely a specific surface functionalization based on gold nanoparticles of carbon nanotubes to achieve selectivity toward hydrogen sulfide, together with the implementation of multiple sensors for self-validation. The second one, on the contrary, focuses on the analysis method, implementing machine learning algorithms to maximize the data obtained from each single sensor to distinguish gases based on their interaction kinetics with the sensor. The combination of both approaches is foreseen as a powerful tool for the development of new smart sensing tools with powerful output in terms of analytical efficiency.

Keywords: gas nanosensors, breath diagnostics, machine learning