

Updated title and summary for one or two proposed lecture topics.

Next Generation of Gas Sensors: Anticipated and Unanticipated Advantages Over Last-Century Designs **Summary for a proposed lecture topic 01**

It is conventionally expected that the performance of existing gas sensors may degrade in the field compared to laboratory conditions because (i) a sensor may lose its accuracy in the presence of chemical interferences and (ii) variations of ambient conditions over time may induce sensor-response fluctuations (i.e., drift). Breaking this status quo in poor sensor performance requires understanding the origins of design principles of existing sensors and bringing new principles to sensor designs. Existing gas sensors are single-output (e.g., resistance, electrical current, work function, light intensity) sensors, also known as zero-order sensors. Any zero-order sensor is undesirably affected by variable chemical background and sensor drift that cannot be distinguished from the response to an analyte.

In this lecture, we will demonstrate that to address these limitations, multivariable gas sensors are emerging as the next generation reliable analytical devices. Multivariable gas sensors (also known as intelligent sensors, multiparameter sensors, high-order sensors, and virtual sensor arrays) are individual sensors that are designed with several independent responses and operate as the first-order analytical instruments. We will present results from our and other research teams that demonstrate three-dimensional, four-dimensional, and even five-dimensional dispersion of individual sensors, differentiation of complex odors and closely related volatiles, and quantification of analytes in mixtures. Next we will discuss recent reported methodologies to improve stability of multivariable sensors. Design principles of electrical and photonic types of first-order sensors open opportunities for diverse emerging monitoring applications that cannot afford relatively high electrical power demands, relatively high instrument acquisition cost, and frequent periodic maintenance, typical of traditional analytical instruments.