# Electronic Nose fabricated from compositionally gradient oxides for Agriculture Applications

Hyejin Park[1], Yoonsung Chung[1], Hosang Ahn[2], Dong-Joo Kim[1]
[1]Materials Research and Education Center, Auburn University, Auburn, AL 36849, USA
[2]Environmental Research Division, Water Resources and Environment Research Department, Korea Institute of Construction Technology, Ilsanseo-Gu, Goyang, Gyeonggi-Do 411-712, Korea

Off-odor detection in foods, packaging materials, and their interactions involving scalping or other flavor system modification can be a serious issue since off-odors or flavors have become more than a quality issue with the increased awareness of food safety problems. Since plants and trees normally release volatile organic compounds (VOCs) as a byproduct of everyday physiological processes, monitoring of the specific VOCs and the quantities released can provide the information on both the crop and field conditions. The electronic nose generally consists of an array of gas sensors with a broad and partly overlapping selectivity and an electronic pattern recognition system with multivariate statistical data processing tools [1, 2].

In this study, a MEMS electronic nose system is investigated to utilize nanostructured metal oxide based on ZnO, SnOx and graphene oxide and their composite film segmented by a series of electrodes to create a high density of sensing array in a small size chip. The novelty of the proposed microarray is based on the formation of a spatially gradient composition, microstructure, and/or temperature through sensing layers where each wire-type electrode induces its unique response pattern. Figure 1 shows an example to fabricate compositionally gradient tin oxides (p-type SnO and n-type SnO2) confirmed by XRD result. Figure 2 also shows sensing properties of SnO, SnO2 and transient SnOx (1<x<2) in a single chip. Such a design meets the requirements for low-cost and high-volume production in combination with high gas analytical performance. The results on the growth of the nanostructured films using solution process and vacuum process are presented. Sensing properties of the devices are also discussed in terms of sensitivity, selectivity and response rate.

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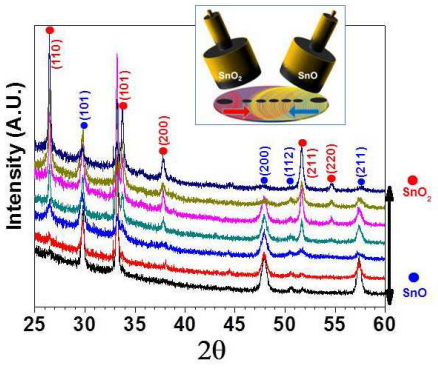


Figure 1: Schematic diagram of compositionally gradient tin oxides prepared by co-sputtering and their XRD graphs of the tin oxides.

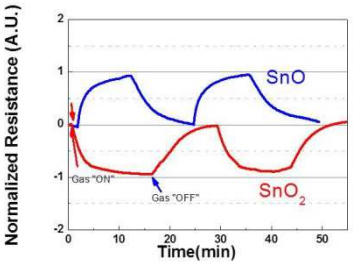


Figure 2: Resistance profile of SnO and $SnO_2$ films grown on a single chip. Ethanol gas sensing properties present p-type SnO and n-type $SnO_2$ behaviors.