UNIVERSITY OF NOTRE DAME

College of Engineering
105E McCourtney Hall
Notre Dame, IN 46556-5602

P 574 631 7432
E ttran6@nd.edu

November 13, 2020

Professor Steve Suib
Field Chief Editor, *Frontiers in Chemistry*

Dear Professor Suib,

On behalf of co-authors Sanggon Kim, Jacob Brady, Faraj Al-Badani, Sooyoun Yu, Joseph Hart, Sungyong Jung, and Nosang V. Myung, I would be very grateful for your consideration of the enclosed full-length review article entitled **"Nanoengineering Approaches Toward Artificial Nose"** for publication in *Frontiers in Chemistry-Analytical Chemistry*. This paper is currently not being considered for publication elsewhere.

Significant scientific efforts have been made to mimic and potentially supersede the mammalian nose using artificial noses based on arrays of individual cross-sensitive gas sensors over the past couple decades. To this end, thousands of research articles have been published regarding the design of gas sensor arrays to function as artificial noses. Of the many chemical gas sensing materials and mechanisms that have been researched over the last few decades, nanoscale materials with high surface area for enhanced reactivity and uniquely tunable optical, electronic and optoelectronic properties have been used and favored as gas sensing materials in single gas sensors and sensor arrays by addressing some of the shortcomings in sensitivity and selectivity inherent in microscale and macroscale materials. In this article, the fundamental gas sensing mechanisms are briefly reviewed for each material class and sensing modality (electrical, optical, optoelectronic), followed by a survey and review of the various strategies for engineering or functionalizing these nanomaterials to improve their gas sensing selectivity, sensitivity and other measures of gas sensing performance. Specifically, we review nanoscale materials and nanoengineering approaches for semiconducting metal oxides, transition metal dichalcogenides, carbonaceous nanomaterials, conducting polymers, and others as used in single gas sensors or sensor arrays for electrical sensing modality. We also discuss the various nano-enabled techniques and materials of optical gas detection modality, including photonic crystals, surface plasmonic sensing, and nanoscale waveguides. Strategies for improving or tuning the sensitivity and selectivity of materials towards different gases are given priority due to the importance of having cross-sensitivity and selectivity towards various analytes in designing an effective artificial nose. Furthermore, optoelectrical sensing, which has to date not served as a common sensing modality, is given some emphasis. We close with some perspective on the future development of artificial noses which utilize optical and electrical sensing modalities, with additional focus on the less researched optoelectrical sensing modality.

We thank you in advance for your editorial endeavors and look forward to an early positive response.

Sincerely,

Thien-Toan Tran, Ph.D.
Assistant Research Professor
Department of Chemical and Biomolecular Engineering
120B McCourtney Hall
University of Notre Dame