

NANO HIGHLIGHT Nano-Composite Metal Oxides for Electronic Noses

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The use of nanoscale technologies for the manufacturing of advanced selective gas sensing probes and devices for electronic noses is a key aim of this project. The development of novel techniques for characterizing materials and device properties at the nanoscale is another aim that this project targets by means of inventing novel & modifying existing mechanical testing methodologies and by using advanced structural analysis tools.

This NIRT highlight discusses recent results of our project related to the selective detection and monitoring of low concentrations of gaseous metabolites, such as isoprene, that are important for medical diagnostics [1-2]. Isoprene gas has the highest concentration among the hydrocarbon metabolites in human breath. Using breath isoprene analysis it is possible to monitor changes in blood cholesterol in a non-invasive manner [3]. It is shown here (figure 1a) that sol-gel processed MoO_3 thin films stabilized and tested at 450°C when used as components of multiple sensor arrays are highly sensitive to 10ppm isoprene in the presence of other interfering gases, in humid air environments. Analysis of trace concentrations of isoprene in simulated and in real human breath samples is currently being underway. These preliminary findings, however, suggest that it might be possible to produce fast, reliable, and non-invasive sensing probes for cholesterol testing using nano-manufactured materials.

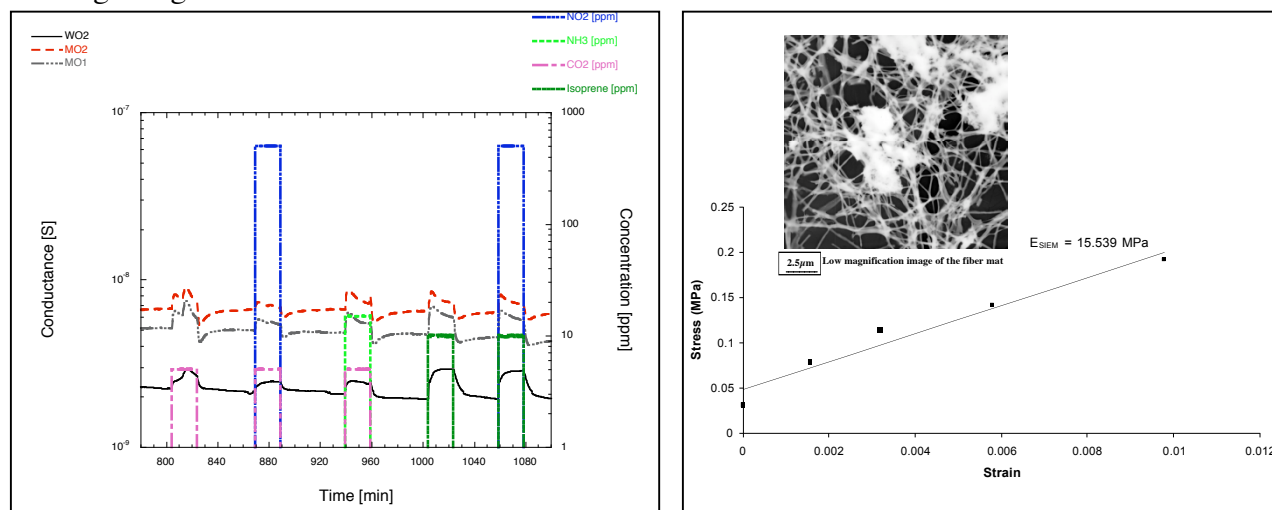


Figure 1: a) Conductance changes are plotted as a function of gas concentration for a three-sensor array exposed to four gases (Isoprene, NO_2 , CO_2 and ammonia); b) (inset) TEM micrograph of a composite (PEO-metal oxide) electrospun membrane; the plot shows the measurement of the Young's modulus for this structure by SPIE method.

Another exciting development involves the processing of novel nanostructures of composite polymer-metal oxides by electrospinning [1]. Using mixtures of oxide sol-gels and polymer solutions non-woven membranes of composite nanofibers have been produced (Fig. 1b (inset)). Speckle Interferometry with Electron Microscope (SPIE) technique has been used to measure the Young's modulus of these composite nanostructures that may be used as flexible substrates of nanoscale electronic devices (Fig. 1b). Recent studies focus on stabilizing the oxide nanowire configurations obtained after removing the polymer, for sensing purposes. Our NIRT team has active collaborations with the Nanocenters of two National Labs (LBL and BNL), the Natick Army Center and the NRL Stennis Center, and the Sensor Lab at the Univ. of Brescia, Italy.

References

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