Sensors made from infiltrated ZnO nanostructures

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With the increased portfolio of materials that can be deposited using atomic layer deposition (ALD) there has been an increased interest in infiltrated metal oxides such as zinc oxide in terms of fundamental understanding of growth properties [1] and for novel device fabrication [2]. In this paper we use an infiltration process named Sequential Infiltration Synthesis (SiS) [3] to fabricate novel UV and gas sensors with high sensitivity. The SiS method utilizes similar concepts of ALD process with the significant difference in process exposure times, pressure, and purpose. The purpose is to allow the precursor gases infiltrate a polymer matrix (e.g SU-8) and allow the reaction to occur inside the polymer matrix. SU8 is a negative resist that allows for localization of the infiltration process for device fabrication [2]. We have used this property to make a device that is UV sensitive, and that is sensitive to ppm concentrations of gases by using SiS of zinc oxide (ZnO).

The large bandgap and semiconductor properties of ZnO allow for a visible-blind ultra violet light sensor. Data showing the results is illustrated in Figure 1. We used a standard UV flashlight that emits at 408 nm as the UV source. We also tested the same device for sensing gases like nitrous oxide and formaldehyde, Figure 2. We show that device can easily detect these gases with concentrations of 5 ppm. The change in current for such low concentrations was measured to be between 25% and 35 %. These results open possibilities of novel sensors using SiS of metal oxides for diverse applications.

References:

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3. Q. Peng, Y.-C. Tseng, S. B. Darling, J. W. Elam, *ACS Nano*, **2011**, 5 4600

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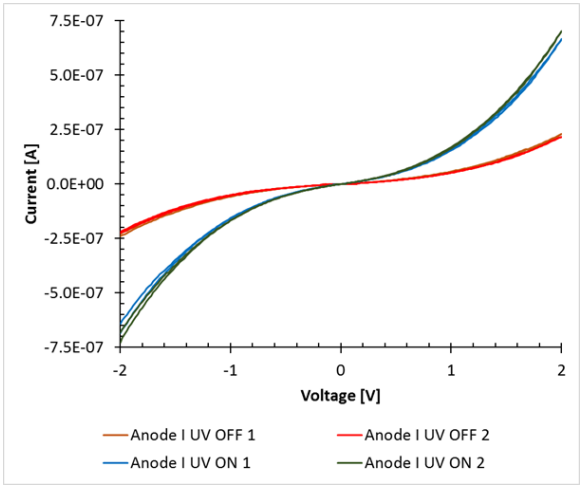
a)



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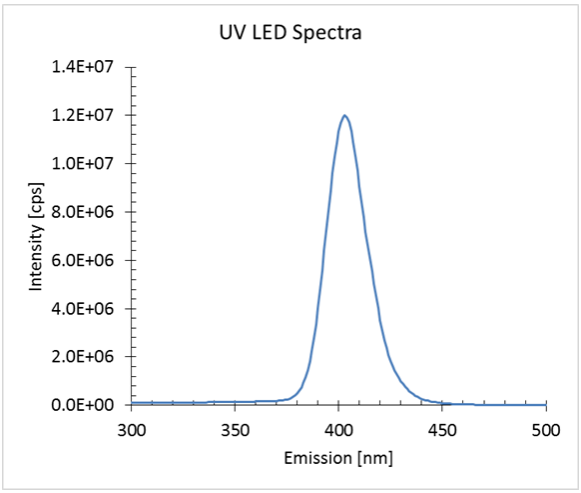

Figure 1. Results for a UV sensor made. a) I-V curves. Red line is with UV light off. Blue lines are with UV light on. b) Emission sprectra of UV light source.

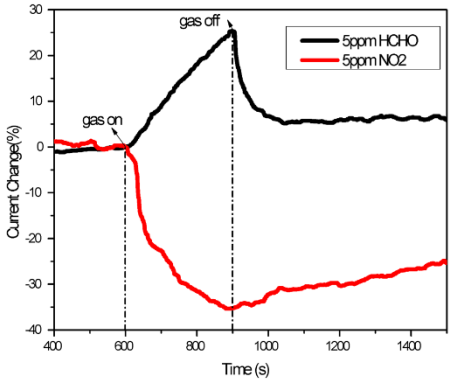

Figure 2. Results of same device as in Figure 1 as a gas sensor. Plot shows current change vs time data when exposing sensor to nitrous oxide (NO_2) and formaldehyde (HCHO). Red line is data for NO_2 exposure and black line is for HCHO exposure.

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