CHEMICAL SENSING WITH AN INTEGRATED PRECONCENTRATOR/CHEMIRESISTOR ARRAY

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In our previous publication [1] we described the preconcentrator (PC)/chemiresistor array hybrid and gave some representative performance data for preconcentration of xylene and methyl salicylate analyte vapors. Chemiresistors are a particularly simple type of chemical sensor whose electrical resistance changes in the presence of certain chemical vapors. There has been a recent upsurge of interest in chemiresistors formed from standard insulating polymers turned into conducting composites by mixing with large (20-40%) volumes of powdered metals, often carbon [2,3]. These sensors are easy to fabricate, can be made very small, and can be read-out by simple low-power circuits measuring DC resistance. By varying the polymer host, these sensors can be selected to sense a very wide variety of volatile organic chemicals. The simple fabrication and electronic read-out (DC) of the chemiresistor allows them to be placed very close to a microfabricated preconcentrator [1]. The resulting small package (dead volume ~ 0.13 cm^3) allows for detection of much lower concentrations of analytes than the chemiresistor alone and provides a method for automatically correcting for baseline drift of the chemiresistors because of the timing of the PC heat pulse. In this presentation we describe experimental results from two different configurations of the hybrid package: one with a lid and a small hole allowing diffusion of analyte into the dead volume and the second using two hybrid packages face-to-face with a chemiresistor array poised only 1.6 mm above the PC. These configurations allow us to study the time dependence of the loading of the PC by diffusion and the effect of geometrical placement of the chemiresistor relative to the PC.

EXPERIMENT

An example of preconcentration of methyl salicylate vapor is given in the Figure. Two hybrids are in the face-to-face configuration with one chemiresistor array poised 1.6 mm above the PC and the other array about 5 mm away in the same hybrid. The figure shows the chemiresistor resistance as a function of time for two almost identical sensors made from polyethylenevinylacetate (PEVA) [1,2]. The vapor was exposed to the hybrids for about 10 minutes. At the time marked on the figure the PC was heated to about 200˚C for 3 seconds. The resistance data points are 2 seconds apart. The large signal on the top trace is from the PEVA sensor poised right over the PC. From both the peak signal and the fast response it is clear that the closer sensor gives a more enhanced signal. Other tests showed that there is only a small temperature rise in the close sensor array from the PC. Other performance data on the quantity of analyte that can be loaded into the preconcentrator by diffusion will be given, as well as comparison of the preconcentration of different analyte vapors.

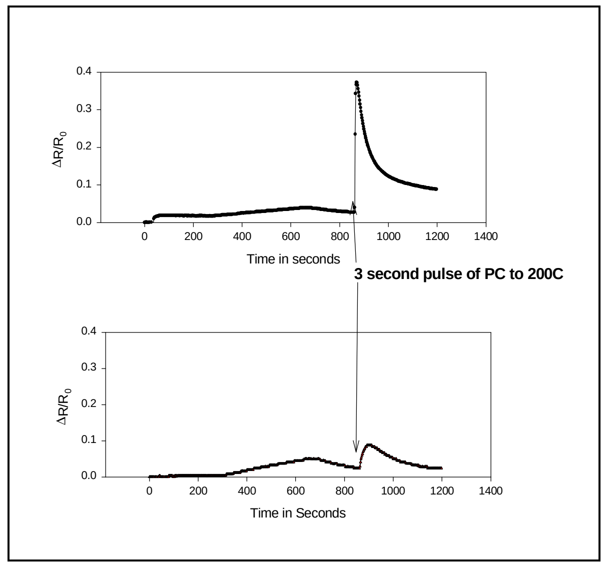

Figure. The resistance signals from two PEVA chemiresistors in two face-to-face hybrids. The upper response is from the chemiresistor poised over the PC, and the lower is from the chemiresistor located laterally (same hybrid) from the PC..

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