Test System for Sensing Materials and Sensors

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A test system for sensing materials and sensors must be able to effectively evaluate both sensitivity and selectivity.

By testing potential sensing materials first, only the very promising sensing materials are deposited, which results in a reduction in time, effort, and cost.

Testing multiple gases at once allows for more realistic environmental conditions.

This test system was used to determine possible sensing materials for form-aldehyde at low concentrations (down to 80 ppb).

Two doped polymers were chosen from eight sensing materials tested.

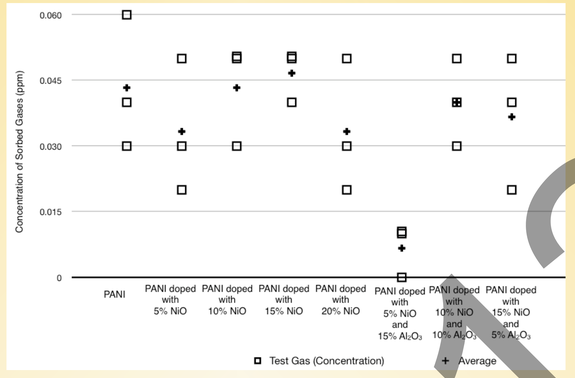
A specialized gas chromatograph (GC) is used to evaluate the interaction between the gases tested for the sensing materials, as well as a standard for gas concentration when testing the full sensor.

A voltage vs. time graph is produced by the GC from which the concentration of each analyte can be determined.

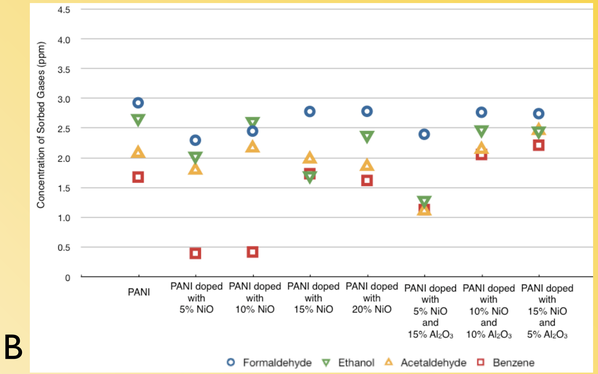
The 50:50 split in gas between the GC and test chamber allows for precise and accurate verification of the concentration of multiple gases tested.

Humidity is added directly to the test chamber where a humidity sensor is placed for verfication.

A



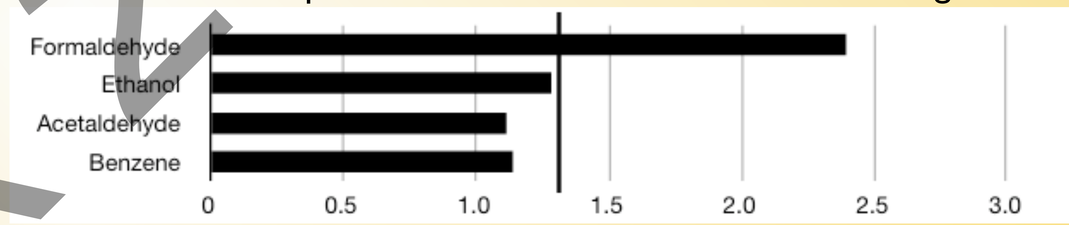
B



Polyaniline (PANI) and PANI doped with NiO and/or Al_2O_3 were tested as possible sensing materials for formaldehyde at low concentrations.

Three replicates were run (A) and the averge response for each gas was plotted (B).

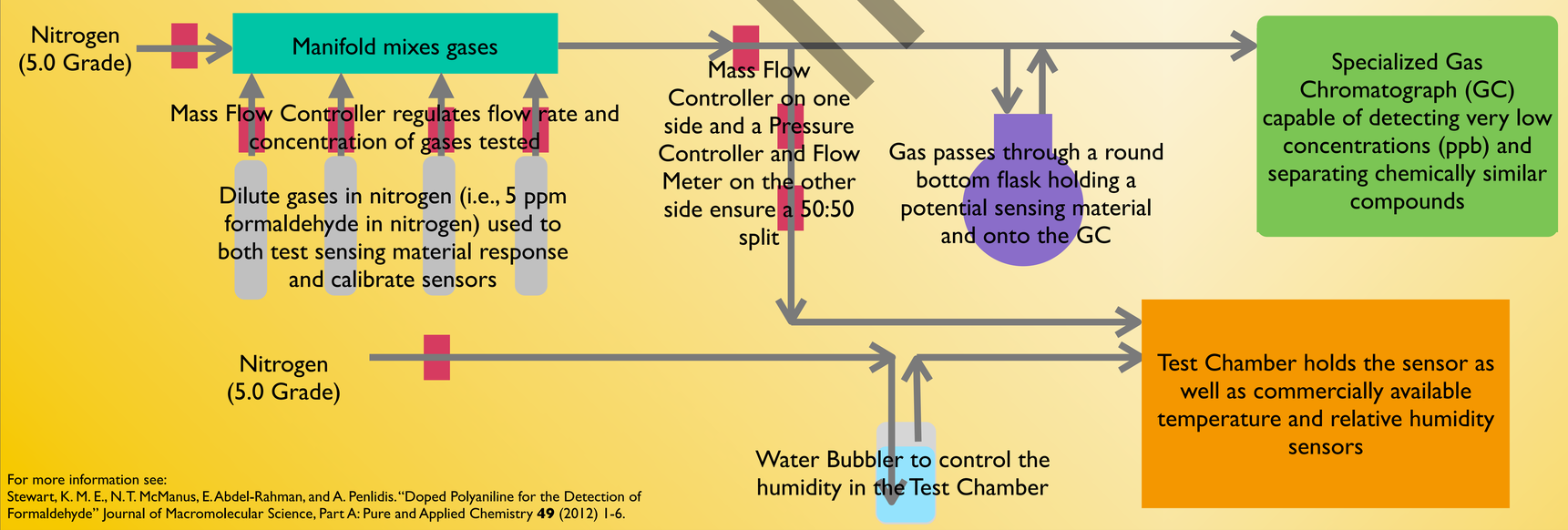
From eight potential sensing materials, two (PANI doped with 5% NiO and 15% Al_2O_3 and PANI doped with 15% NiO) were chosen to be deposited onto the sensor for further testing.



The graph above shows the selectivity of the sensing material PANI doped with 5% NiO and 15% Al_2O_3.

For good selectivity, the target analyte (formaldehyde) should be above the vertical line (representing selectivity equal to 1.75) and the interferents should be below.

PANI doped with 5% NiO and 15% Al_2O_3 had good selectivity towards formaldehyde.

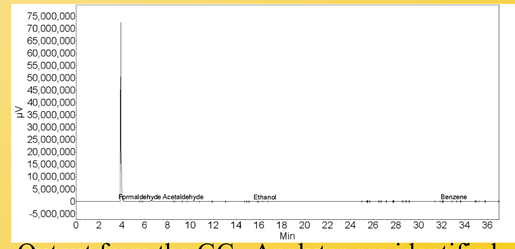


$$[Analyte]_{Sorbed} = [Analyte]_{Total} - [Analyte]_{Residual}$$

$$Sensitivity = \frac{[Analyte]_{Sorbed}}{[Analyte]_{Total}}$$

$$Selectivity = \frac{[Gas\ 1]}{[Gas\ 2]}$$

Selectivity of Gas 2 with respect to Gas 1



Output from the GC. Analytes are identified based on time required to pass through the column.

For more information see:
Stewart, K. M. E., N. T. McManus, E. Abdel-Rahman, and A. Penlidis. "Doped Polyaniline for the Detection of Formaldehyde" Journal of Macromolecular Science, Part A: Pure and Applied Chemistry **49** (2012) 1-6.