



Award ID 1560235

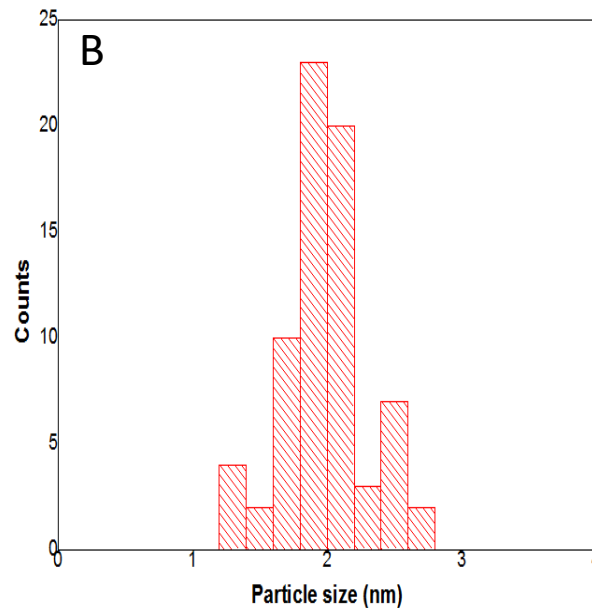
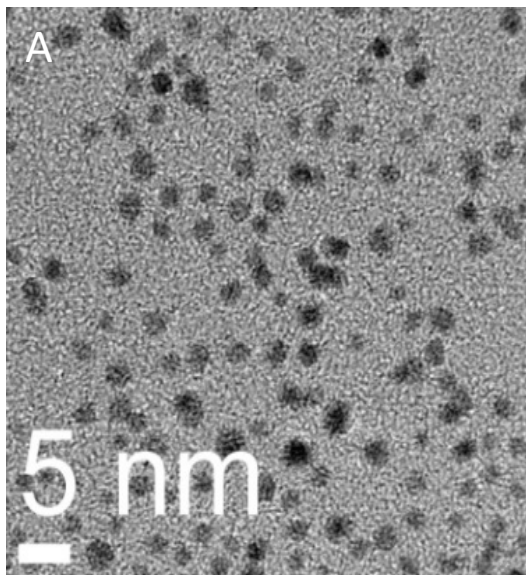


# Microfabricated Sensor for Detection of Trace VOCs

Josh Brodzik, Zhenzhen Xie, and Xiao-An Fu

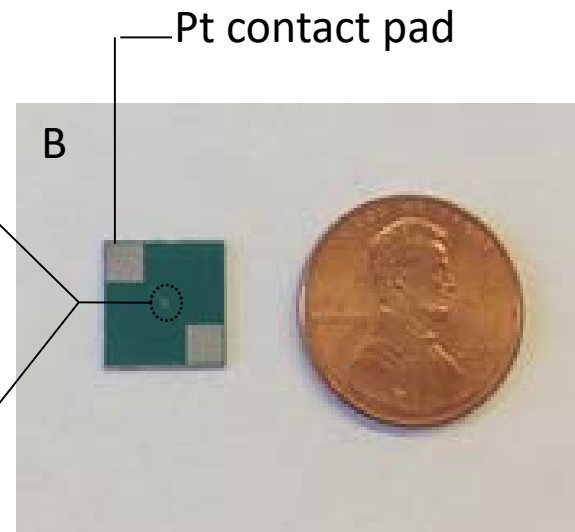
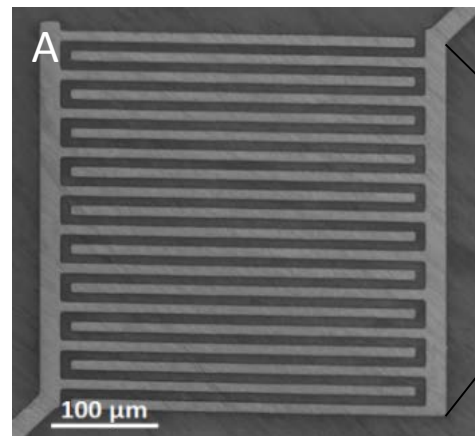
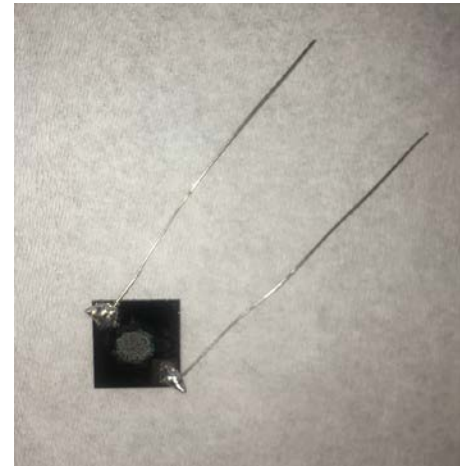
# Gold Nanoparticle Chemiresistors

- Chemiresistor
- Made of Metal Oxides
- Why Are They Studied



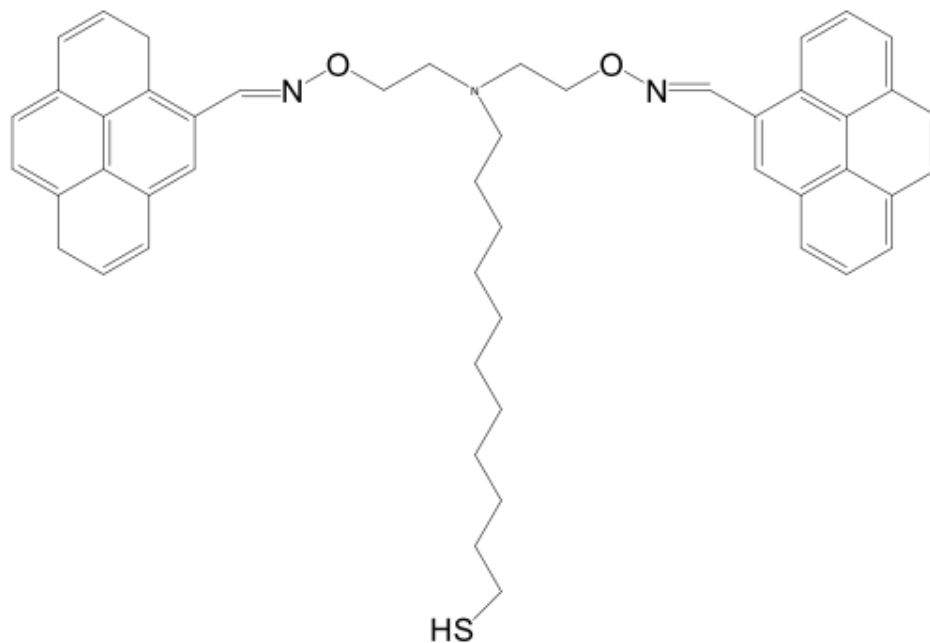
# Sensor Fabrication

- Sensor Testing
- Clean Sensors
- Attach Wires
- Add Synthesized GNP
- Drying



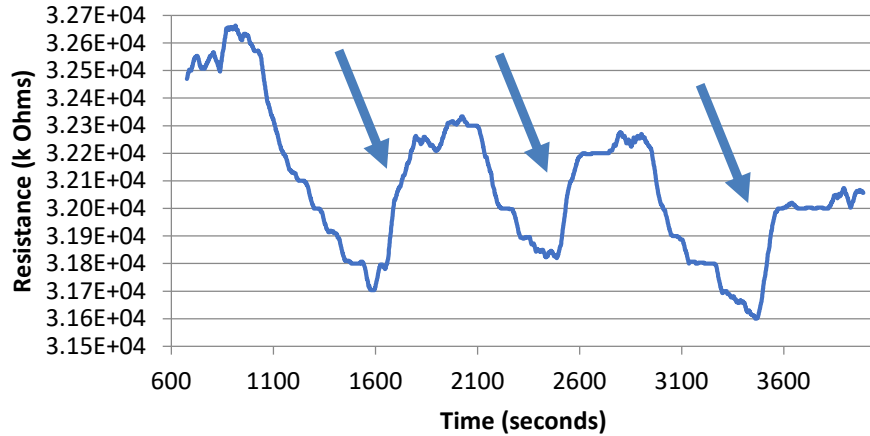
# Thiol for Sensing Benzene

- $C_{49}H_{53}N_3O_2S$
- Designed for Detecting Trace Amounts Benzene

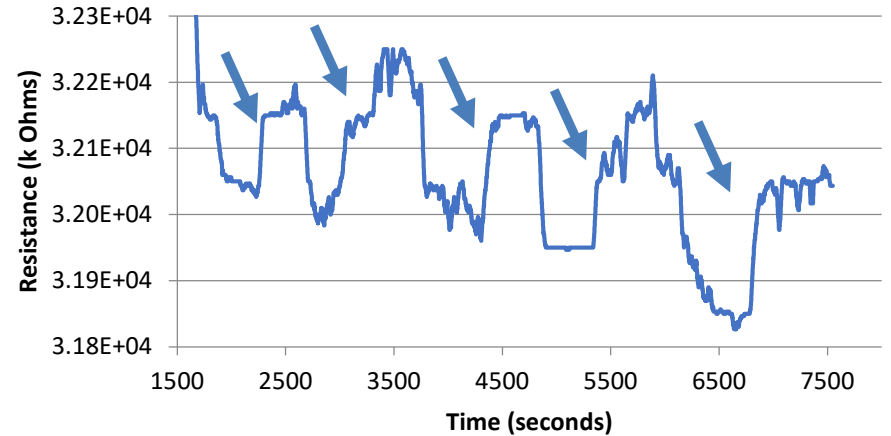


# Benzene Flow Results

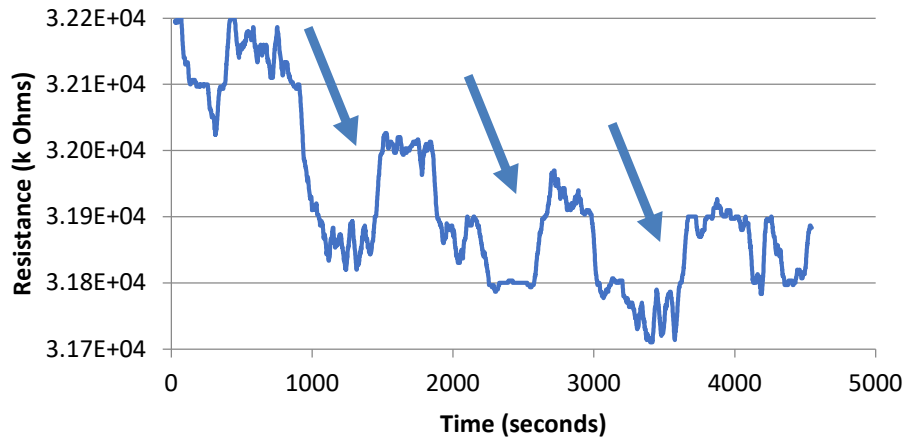
## 10 ppm Benzene Flow



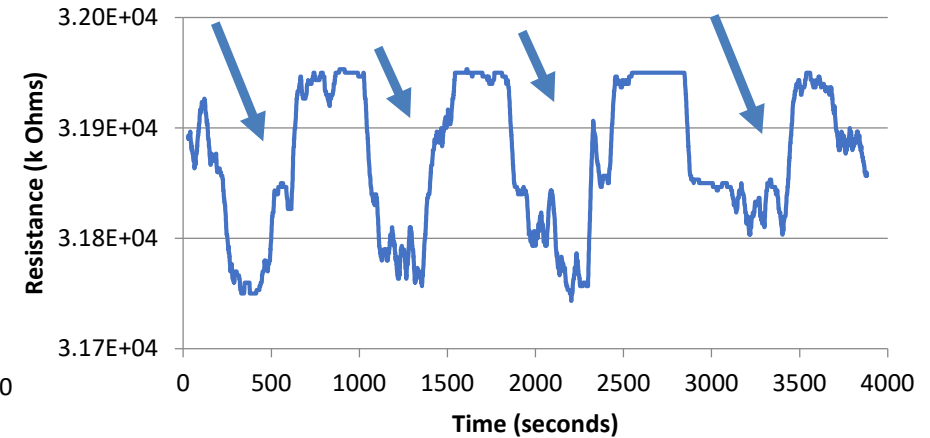
## 5 ppm Benzene Flow



## 1 ppm Benzene Flow

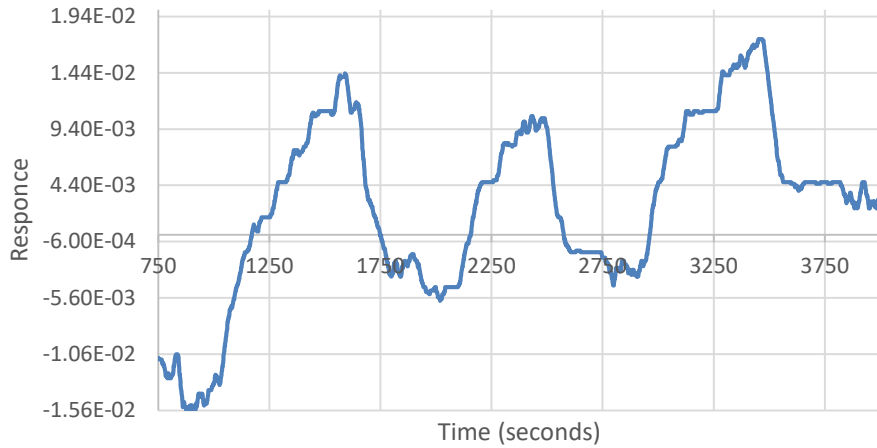


## 0.5 ppm Benzene Flow

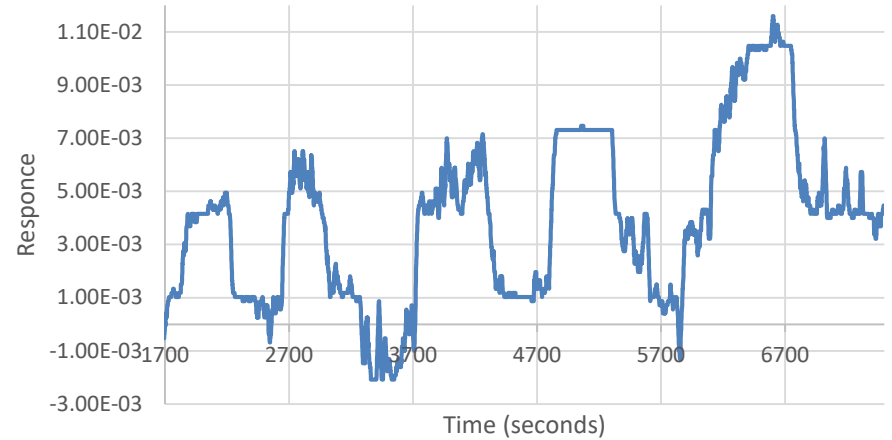


# Benzene Flow Results

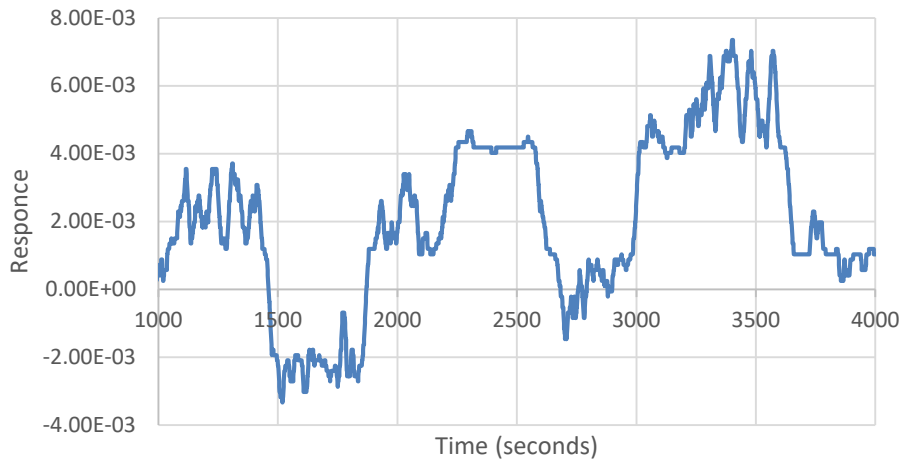
## Sensor Response for 10 ppm Benzene Flow



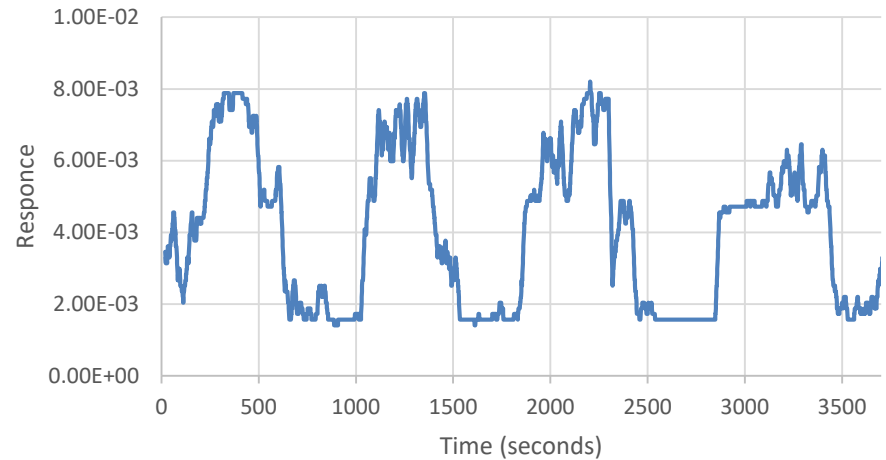
## Sensor Response for 5 ppm Benzene Flow



## Sensor Response for 1 ppm Benzene Flow

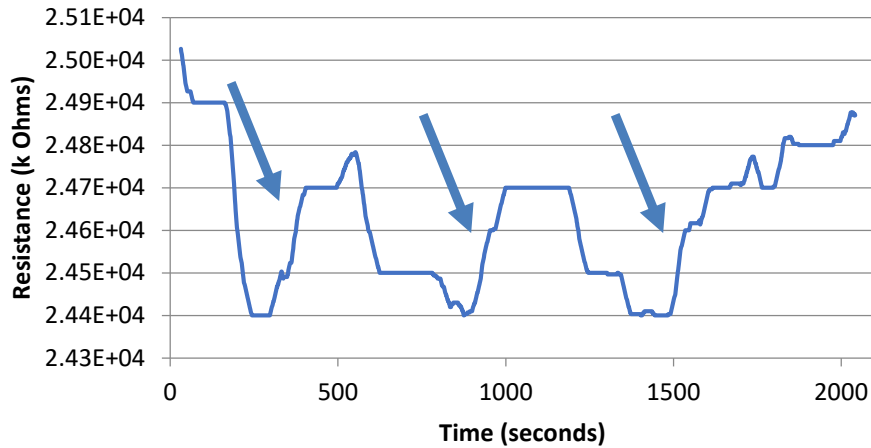


## Sensor Response for 0.5 ppm Benzene Flow

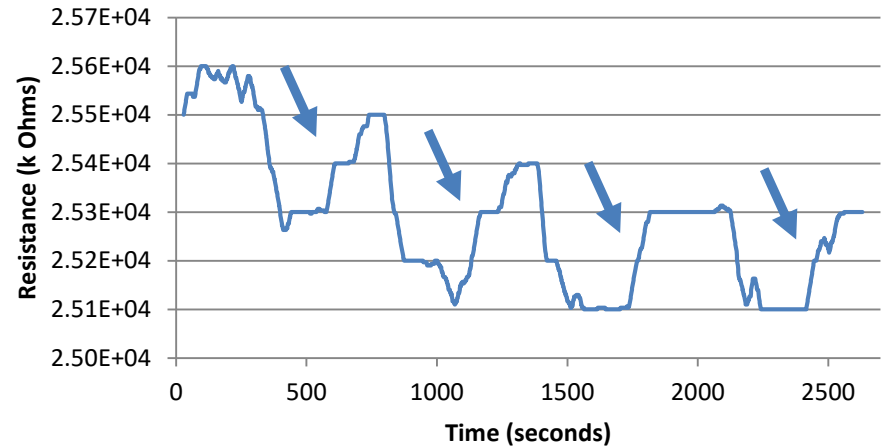


# Acetone Flow Result

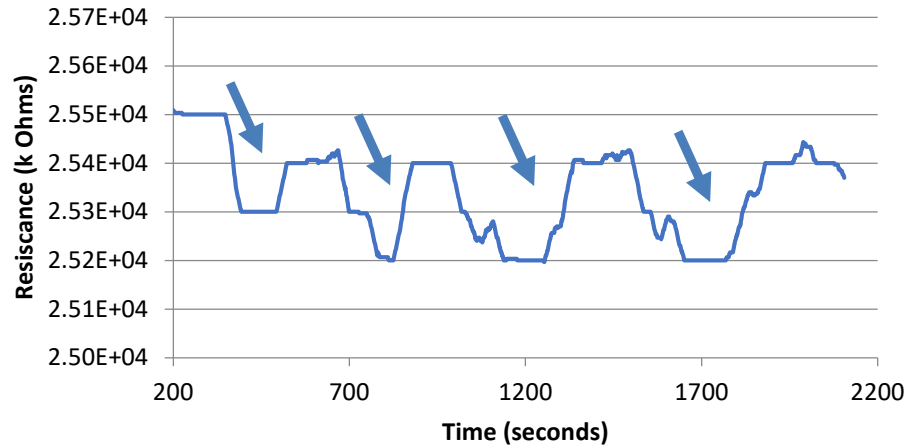
## 10 ppm Flow of Acetone



## 5 ppm Flow of Acetone

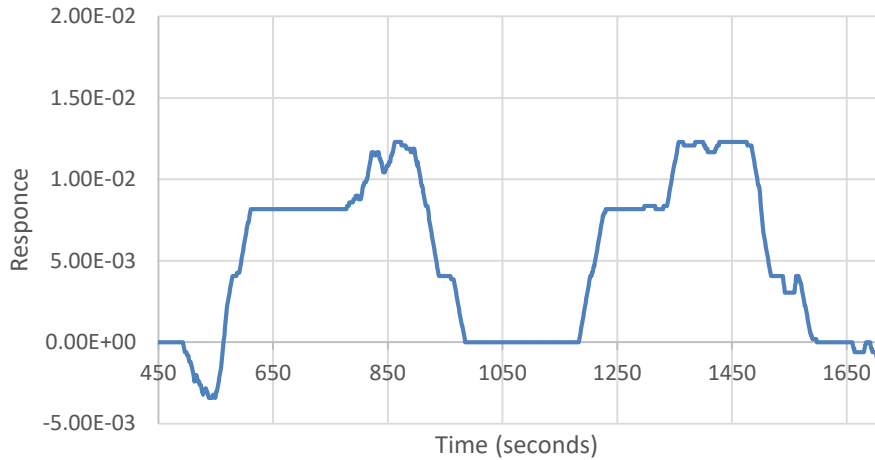


## 1 ppm Flow of Acetone

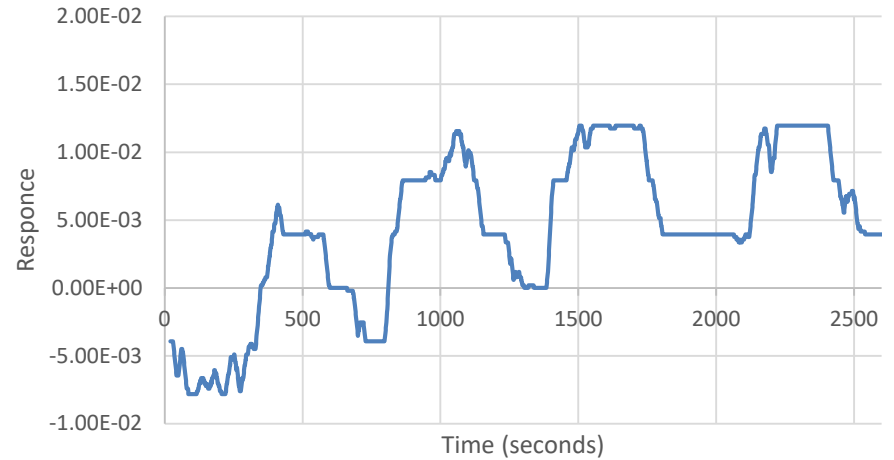


# Acetone Flow Result

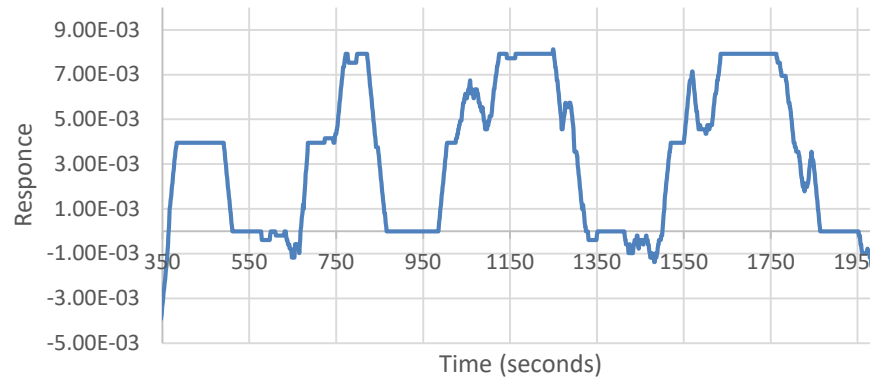
## Sensor Response for 10 ppm Acetone Flow



## Sensor Response for 5 ppm Acetone Flow



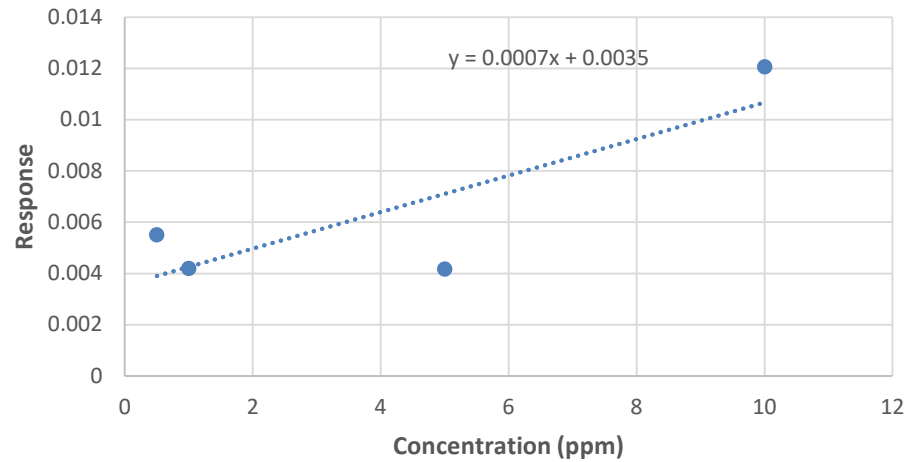
## Sensor Response for 1 ppm Acetone Flow



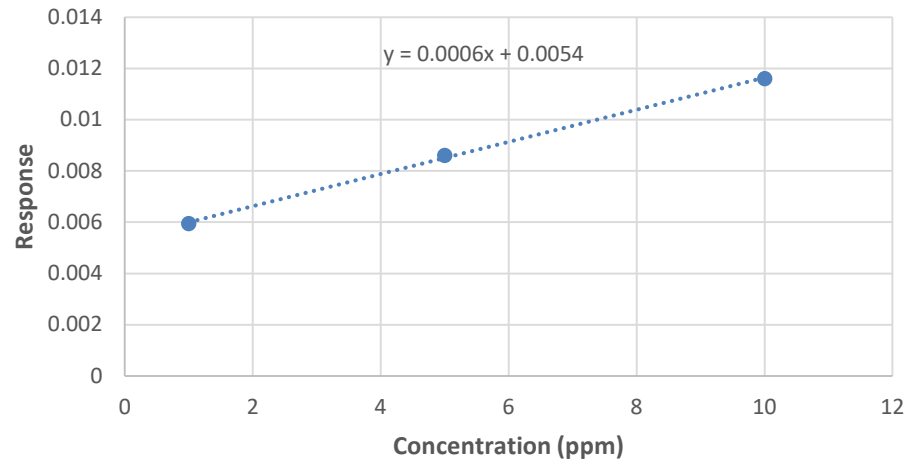


# Response for Benzene Sensor

## Response of Concentration Benzene Flow

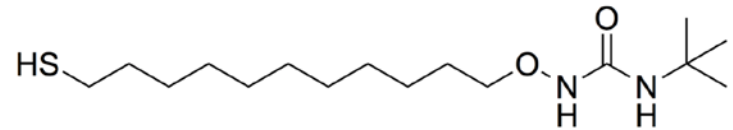


## Response to Concentrations of Acetone Flow

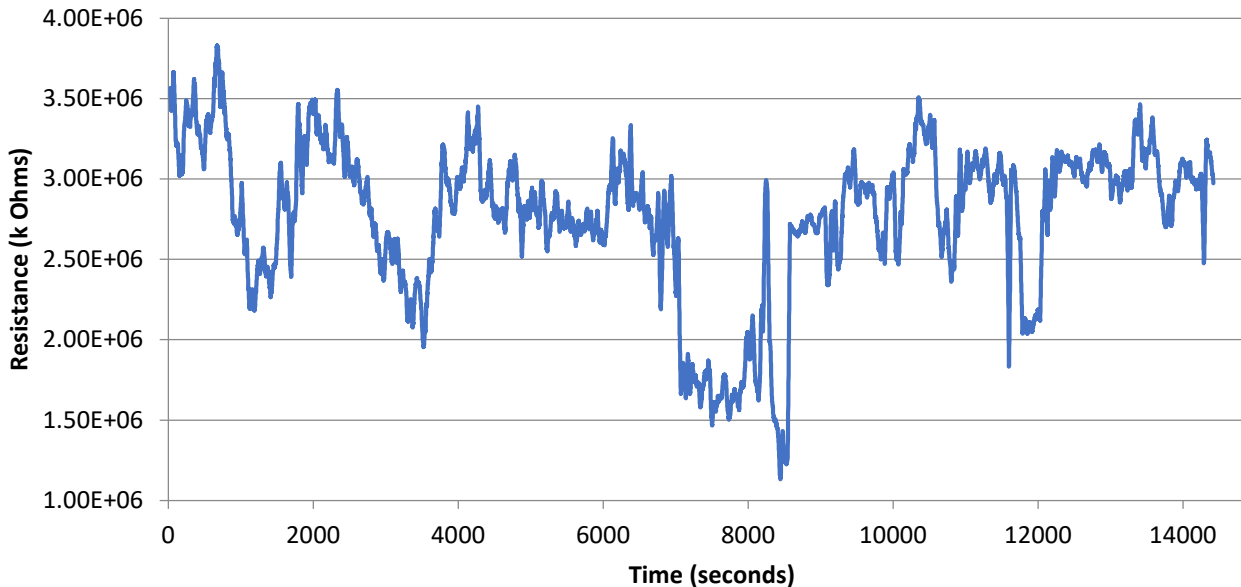


# Monoalkoxy Thiol for Sensing Acetone

- *tert*-butyl monoalkoxy urea thiol
- Designed for sensing acetone

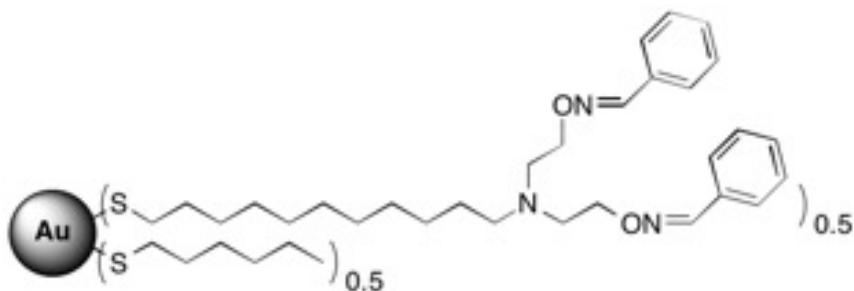


**10 ppm Flow of Acetone**

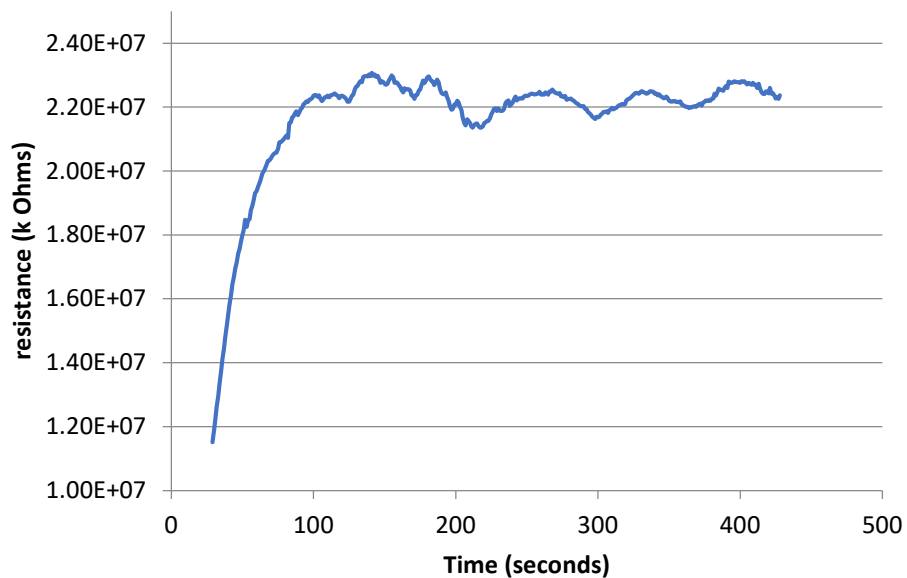


# Benzaldehyde Thiol for Sensing Benzene

- $C_{28}H_{40}O_2N_3S$
- Designed for Detecting Trace Amounts Benzene

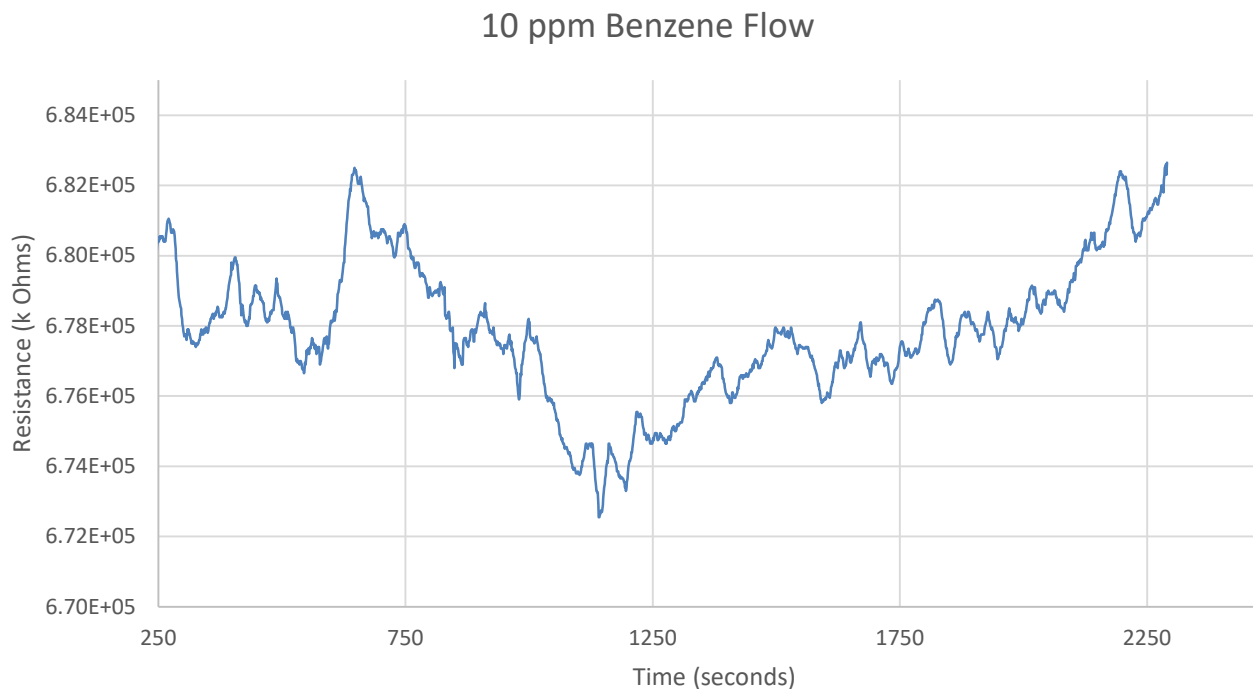
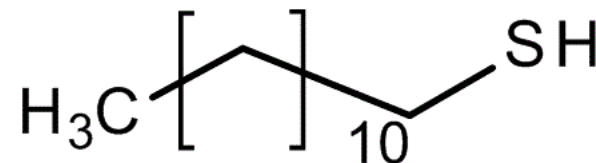


10 ppm Benzene Flow



# Dodecanethiol for Sensing Benzene

- $C_{12}H_{26}S$
- Commercial made thiol



# Summary

- Synthesized vs. Commercial
- 10 ppm to 500 ppb Limit of Detection
- Sensitivity of .0007 for benzene flow and .0006 for acetone flow

# References

- Peng, G., Tisch, U., Adams, O., Hakim, M., Shehada, N., Broza, Y. Y., . . . Haick, H. (2009). Diagnosing lung cancer in exhaled breath using gold nanoparticles. *Nature Nanotechnology*, 4(10), 669-673. doi:10.1038/nnano.2009.235
- Xie, Z., Raju, M. V. R., Brown, B. S., Stewart, A. C., Nantz, M. H., & Fu, X. (2017). Electronic Nose for Detection of Toxic Volatile Organic Compounds in Air. *Solid-State Sensors, Actuators and Microsystems*, 1425–1428.
- Güntner, A. T., Koren, V., Chikkadi, K., Righettoni, M., & Pratsinis, S. E. (2016). E-Nose Sensing of Low-ppb Formaldehyde in Gas Mixtures at High Relative Humidity for Breath Screening of Lung Cancer? *ACS Sensors*, 1(5), 528–535. <https://doi.org/10.1021/acssensors.6b00008>