NANO HIGHLIGHT
Nanoscale Ionization Detectors for Chemical Sensing

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First responders rushing to the site of an emergency require chemical sensors that are compact, light-weight, low-power and can provide sensitive and specific diagnostic signals in real-time mode. Presently there is no portable sensor that meets all of the above requirements. To meet this challenge our group has developed a nanoscale field ionization detector that uses nanostructured electrodes to ionize gas species in real-time mode and at the fraction of the power of a traditional ionizer. The geometry induced electric field amplification effect associated with the sharp tips of the nanostructure allows for ionization at extremely low voltages. The onset voltage at which ionization takes place is a characteristic of the gas and provides a fingerprint to identify the gas and lower the rate of false alarms which is a major problem with traditional portable gas analyzers. Moreover by reducing electrode spacing to below the gas mean free path, our group has been able to prevent cascade collisions and engineer ballistic transport of ionized gas molecules to the sensing electrode. This can allow for selective ionization of gases in mixtures enabling high sensitivity and high specificity of the recognition. These results were published [2-3] in 2003 in Nature and in 2004 in Applied Physics Letters.

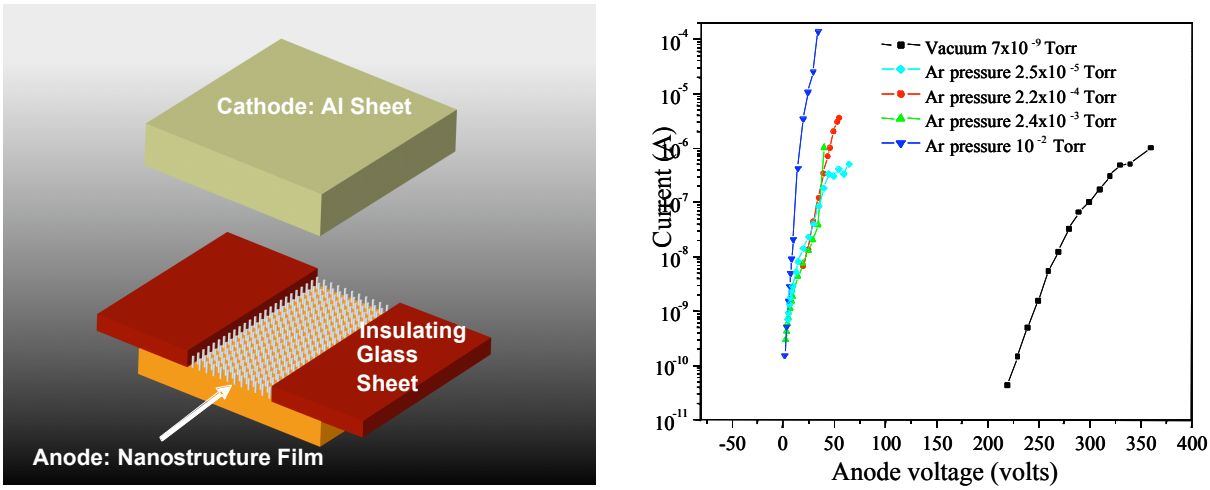

Figure 1: (Left) schematic of the nanoscale gas ionization device. (Right) typical results showing stable ionization discharge for argon at extremely low operating voltages (3-4 Volts).

While nanostructured electrodes have been heavily researched for field emission, their application for field ionization has yet to be explored. The ability to ionize gas species at a few volts electric potential (figure 1) is a remarkable result and this can have broad impact in a range of areas including sensors, ions pumps, field ionization mass spectrometry and FIB technology.

References

[1] For further information about this project link to **<www.rpi.edu/~koratn>** or email **<koratn@rpi.edu>**
[2] J. P. Singh, N. Koratkar, T. Karabacak, T.-M. Lu and G.-C. Wang, "Field ionization of argon using β-phase W nanorods," Applied Physics Letters, Vol. 85, No. 15, pp. 3226-3228, (2004).
[3] A. Modi, N. Koratkar, E. Lass, B. Wei and P. Ajayan, "Miniaturized gas ionization sensors using carbon nanotubes", Nature, Vol. 424, pp. 171-174, (2003).