Defense Science and Technology Seminar on Emerging Technologies

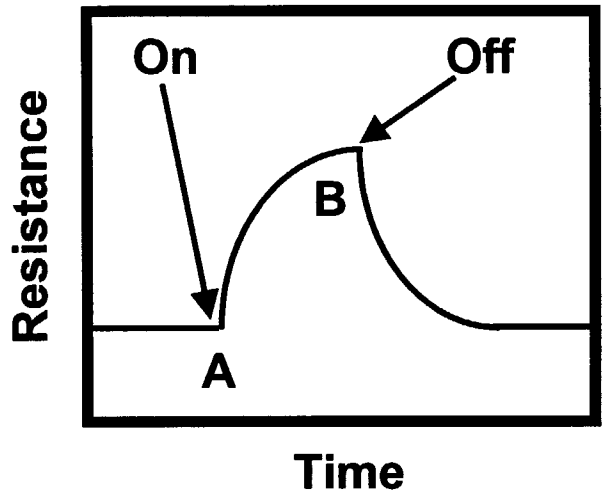
BIOMIMETICS

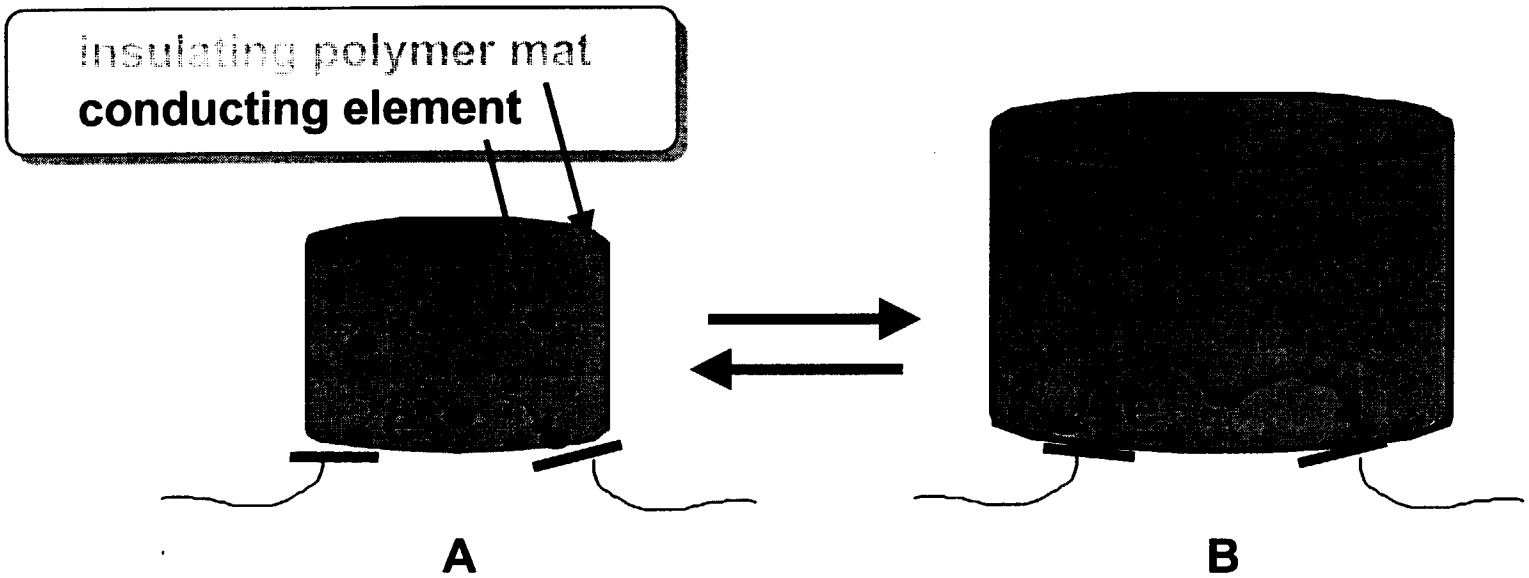
Mimicking the Sense of Smell: Towards an Electronic Nose Using Arrays of Conducting Polymer Composite Vapor Sensors

Professor Nathan Lewis
California Institute of Technology, Pasadena, CA
Phone: (626) 395-6335
Fax: (626) 795-7487

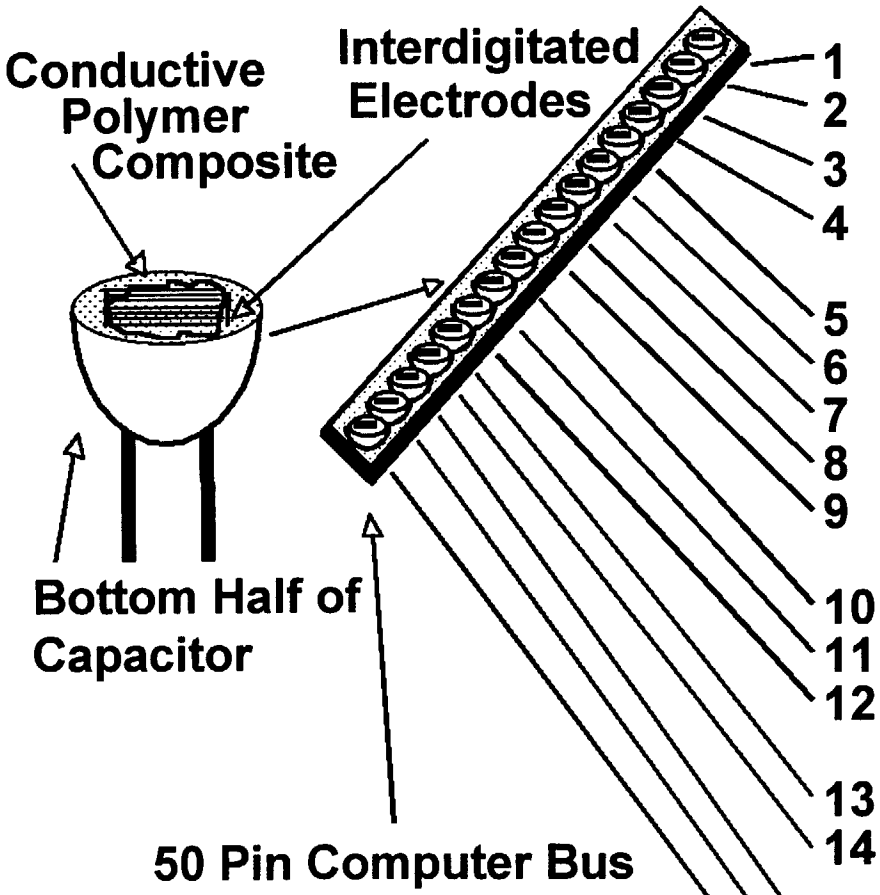
8 January 1999

Swelling-Induced Resistance Changes





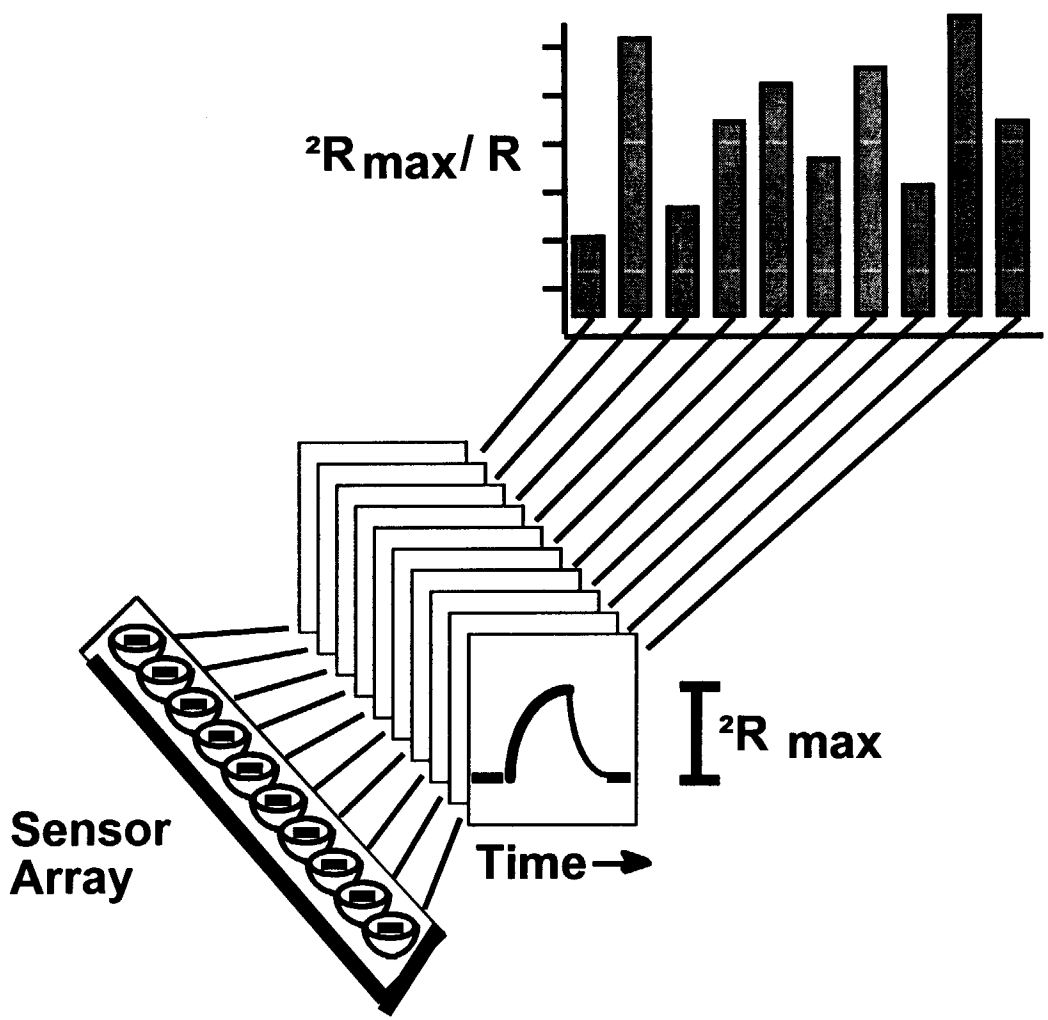
Carbon Black Composite Sensor Array



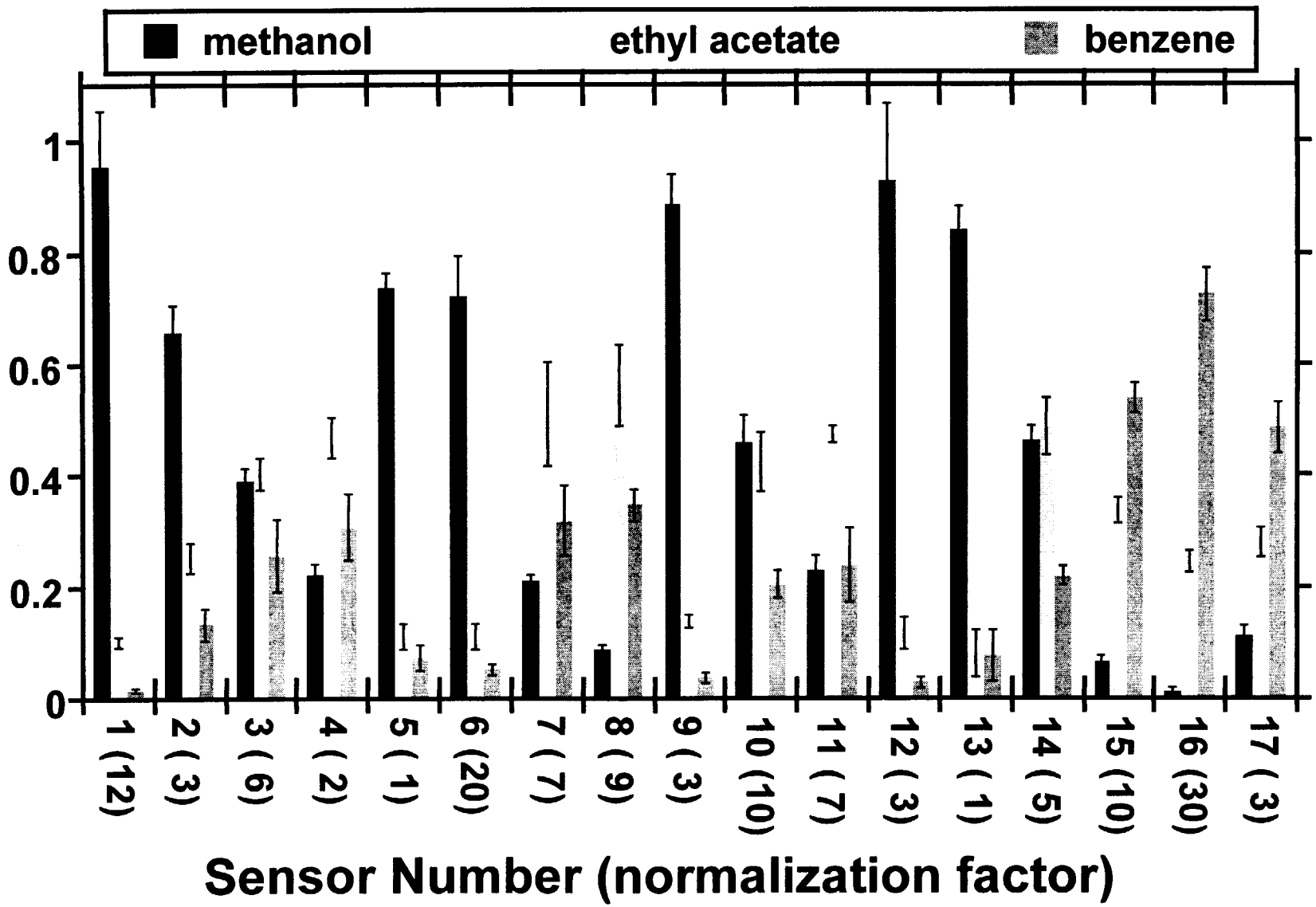
Insulating polymer

1. poly(4 - vinyl phenol)
2. poly(styrene - *co* - allyl alcohol)
3. poly(α - methylstyrene)
4. poly(vinyl chloride - *co* - vinyl acetate)
5. poly(vinyl acetate)
6. poly(*N* - vinylpyrrolidone)
7. poly(carbonate bisphenol A)
8. poly(styrene)
9. poly(styrene - *co* - maleic anhydride)
10. poly(sulfone)
11. poly(methyl methacrylate)
12. poly(methyl vinyl ether - *co* - maleic anhydride)
13. poly(vinyl butyral)
14. poly(vinylidene chloride - *co* - acrylonitrile)
15. poly(caprolactone)
16. poly(ethylene - *co* - vinyl acetate)
17. poly(ethylene oxide)

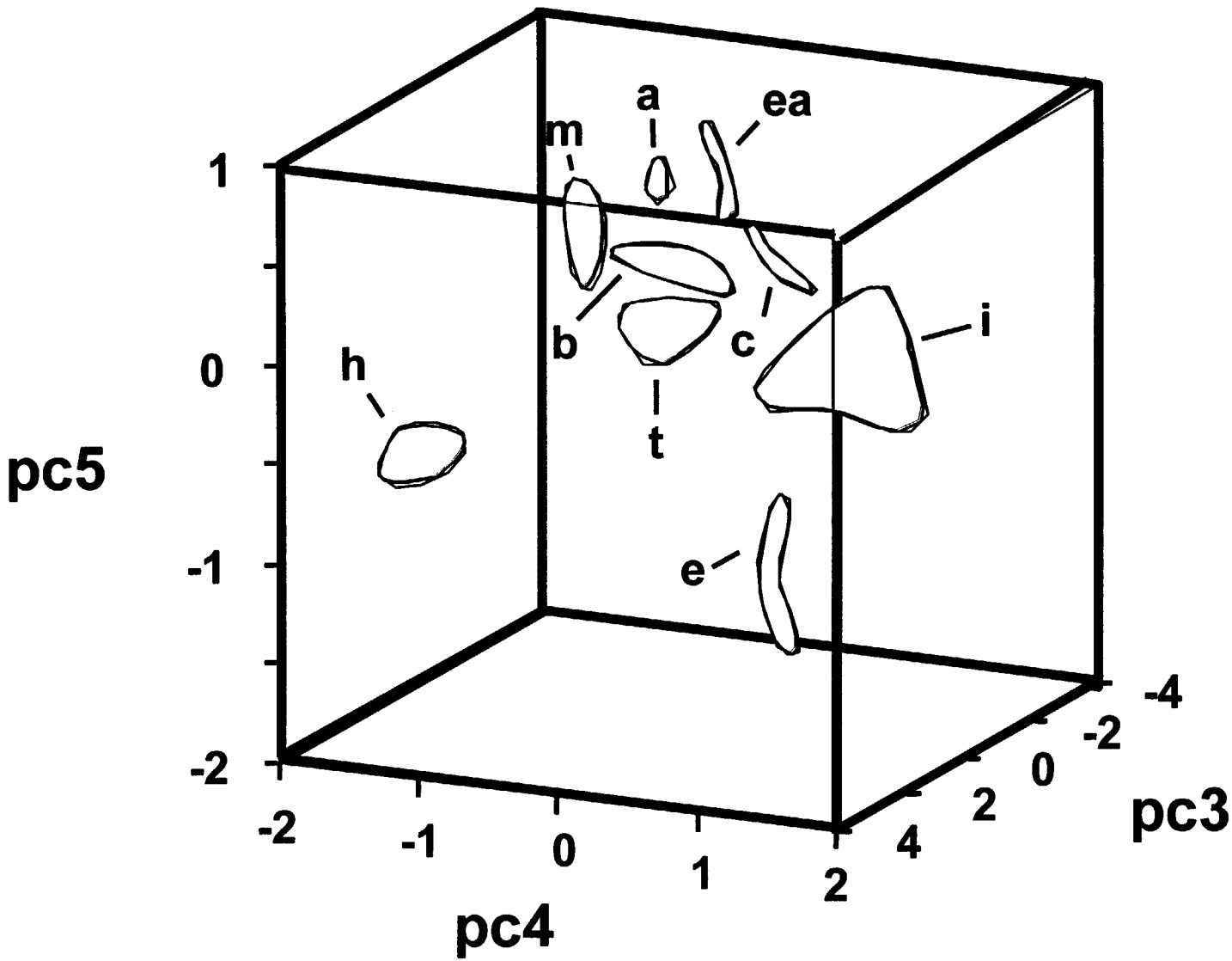
Data Manipulation



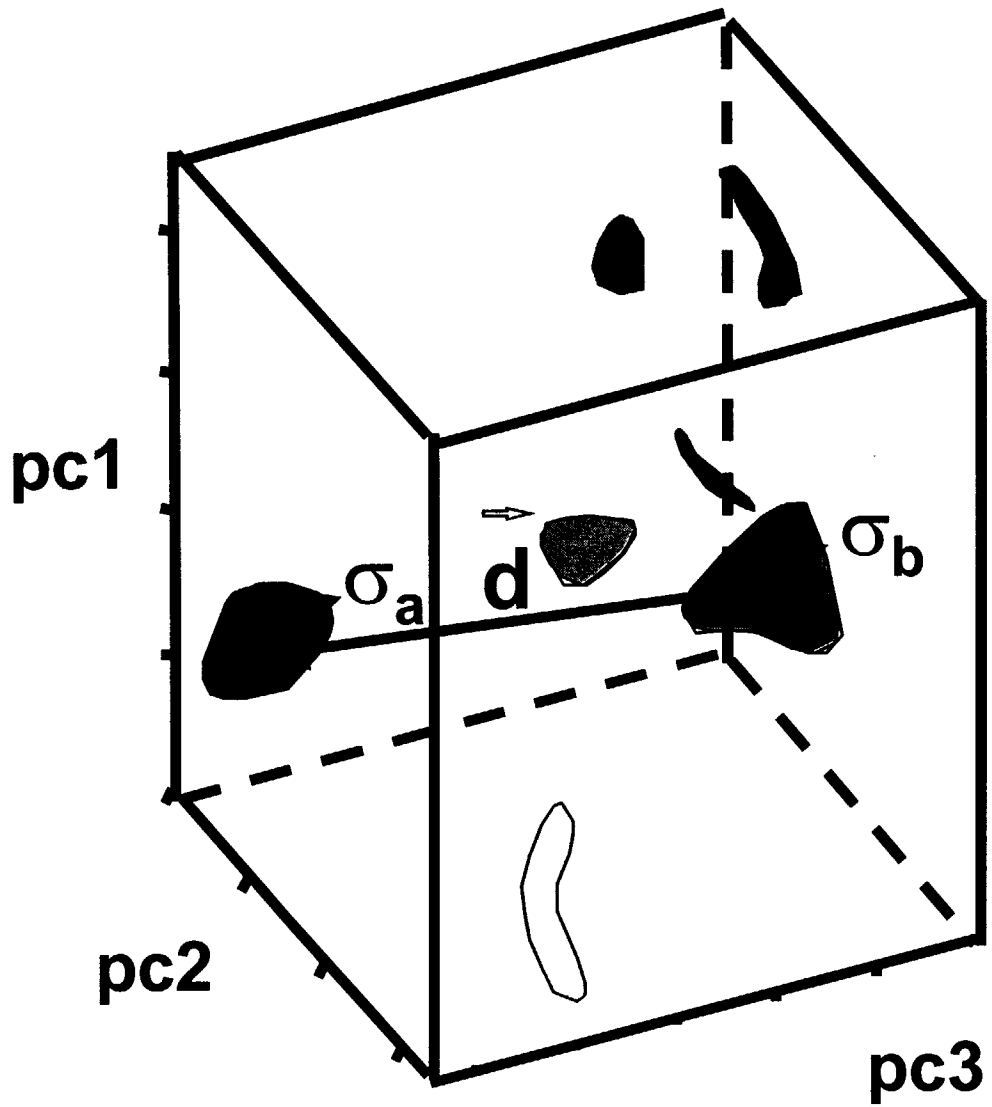
Different Patterns for Different Vapors



Carbon Black-Based Array

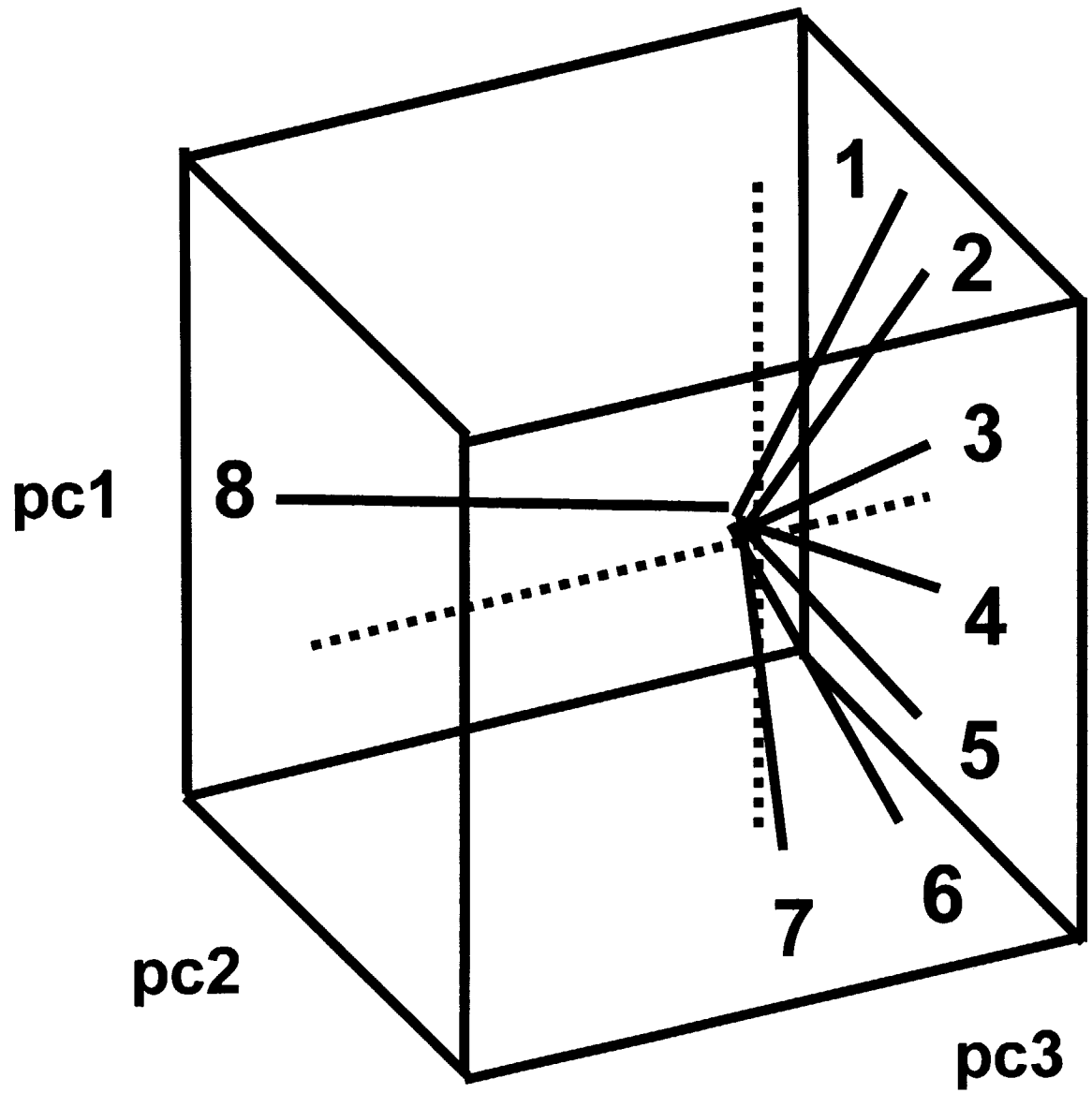


Generalized Resolution Factor

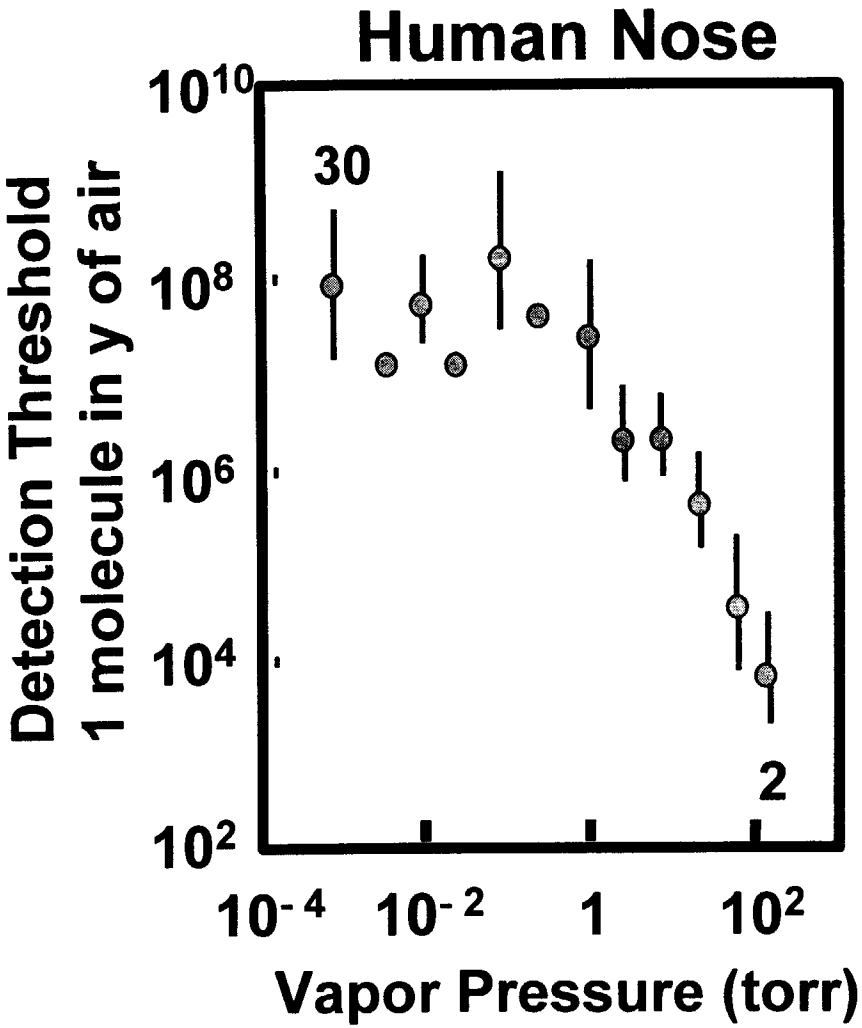


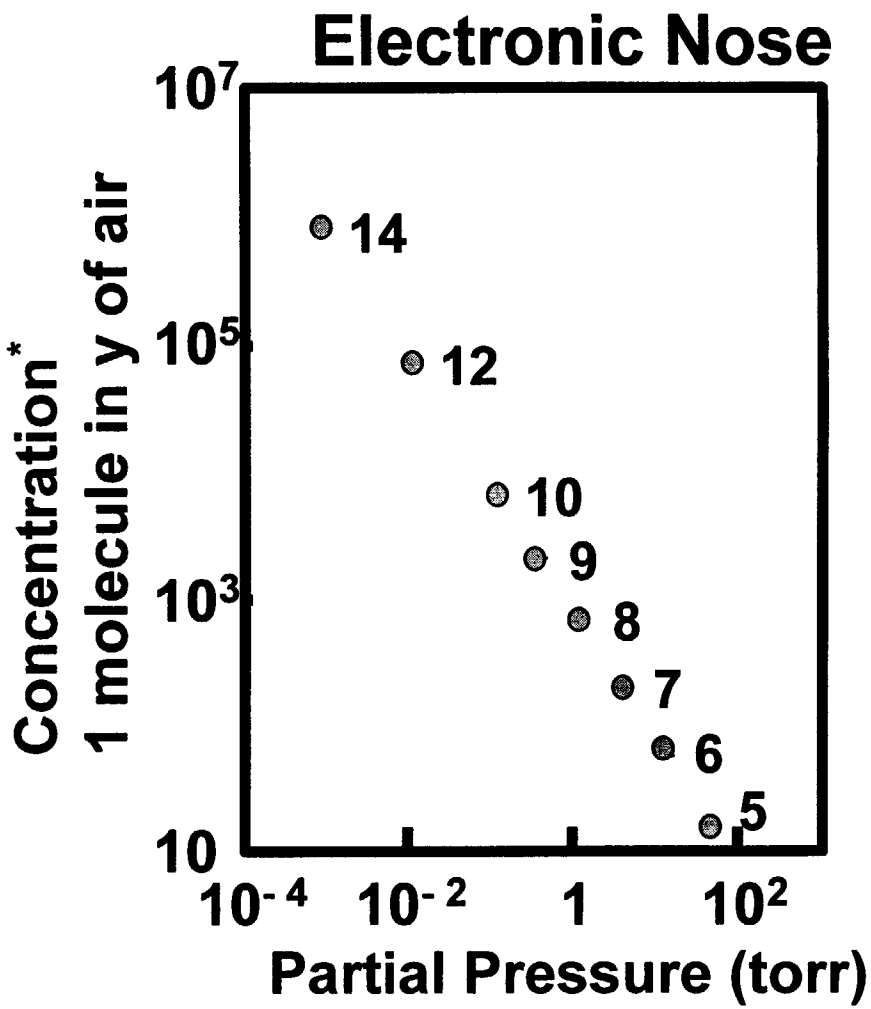
$$rf = \frac{|\vec{d}|}{\sqrt{\sigma_a^2 + \sigma_b^2}}$$

Array Response to Primary Alcohols



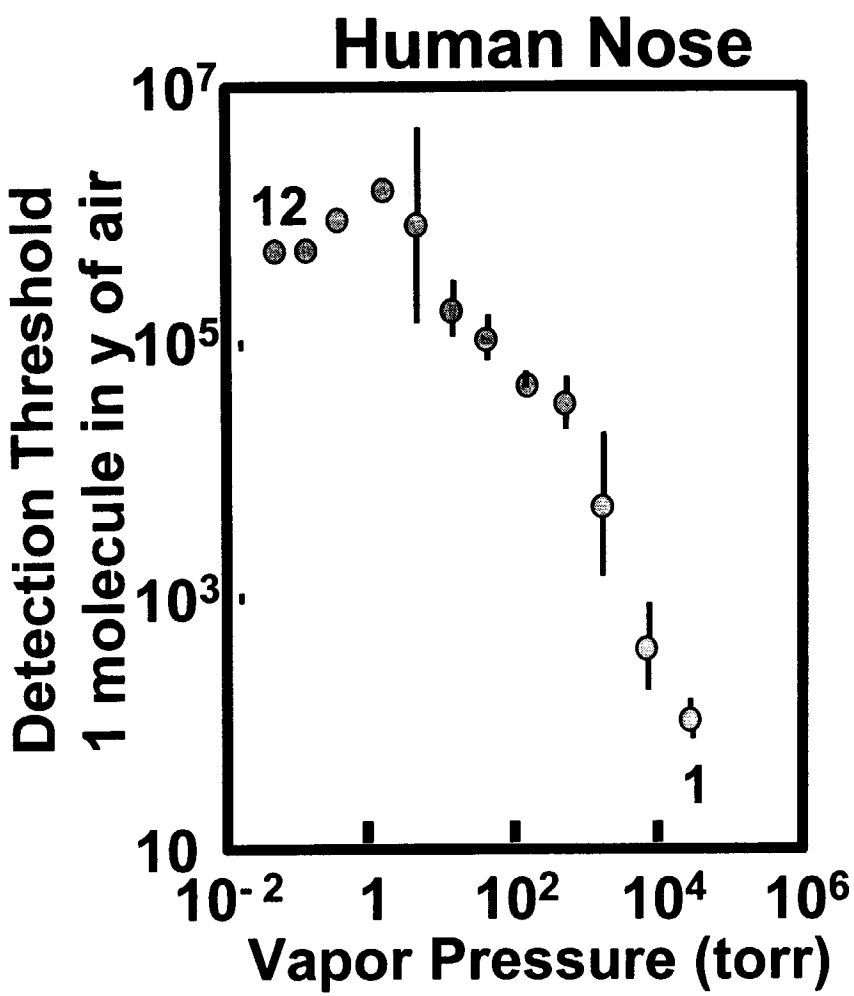
Humans vs Electronic Nose (Alkanes)

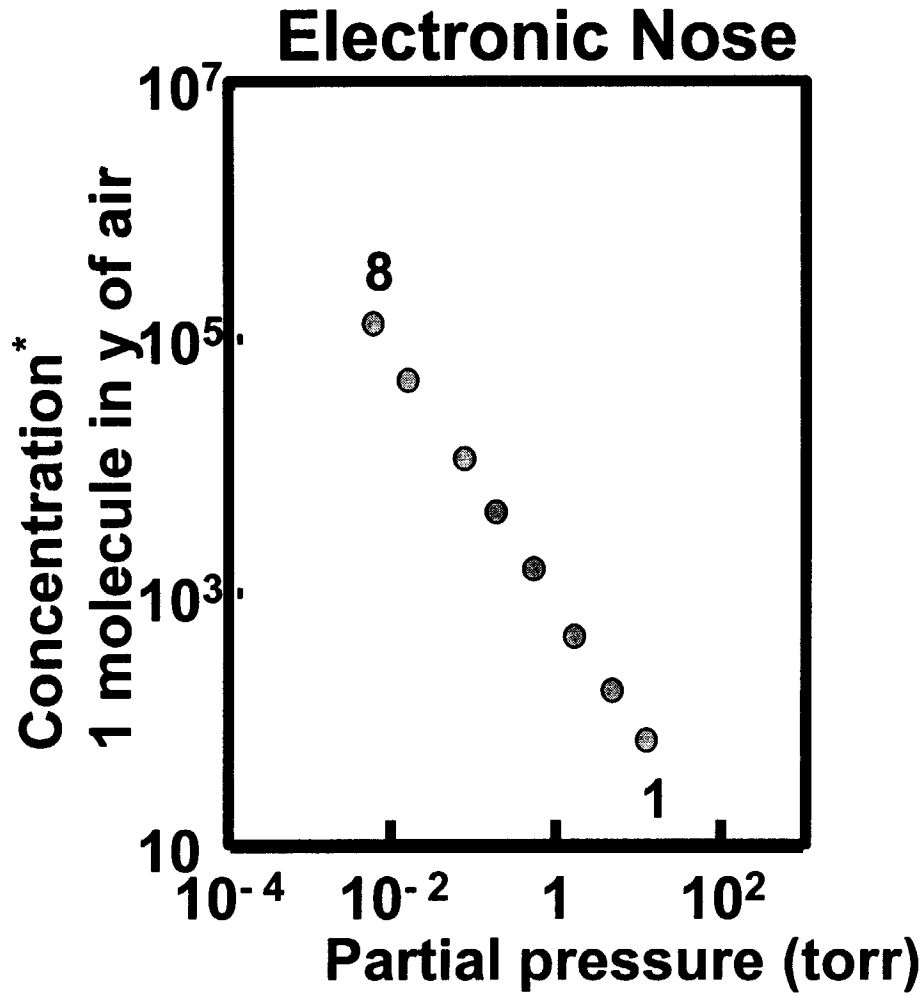




* Concentration required to Achieve 1% Change in Resistance

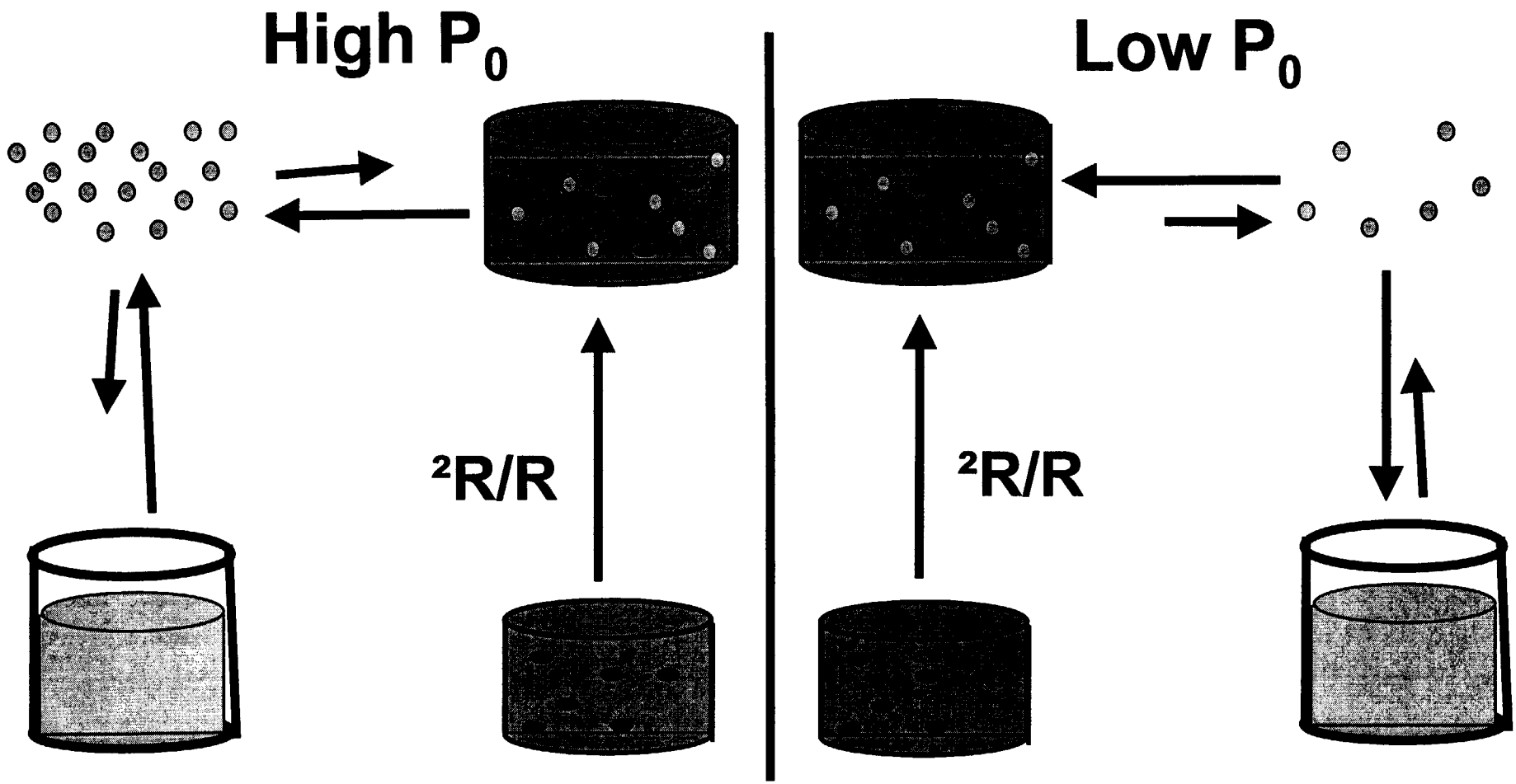
Humans vs Electronic Nose (Alcohols)





* Concentration required to Achieve 1% Change in Resistance

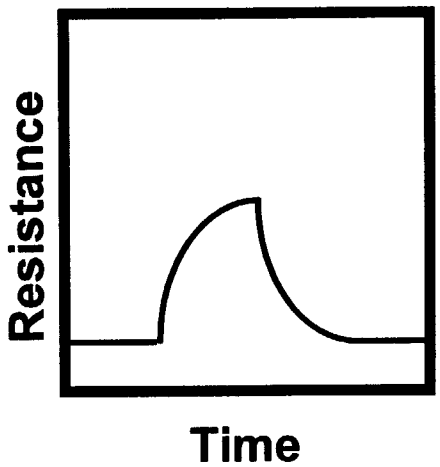
$$\chi = (P/P_o)$$

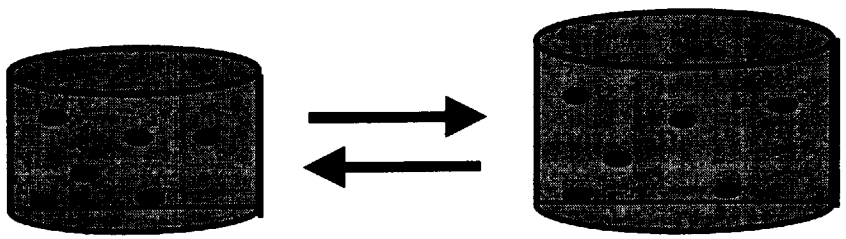


Natural Rejection of High Vapor Pressure Analytes

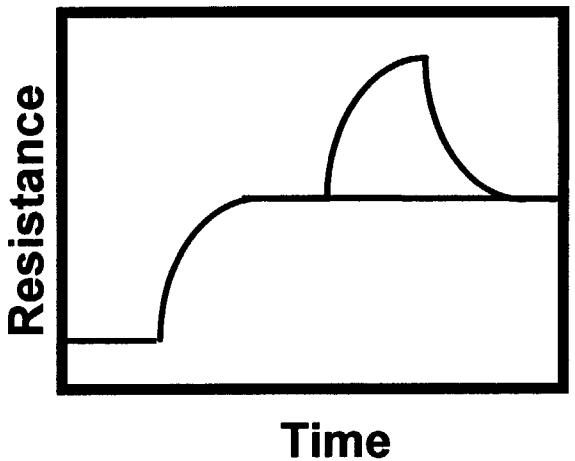
Baselines

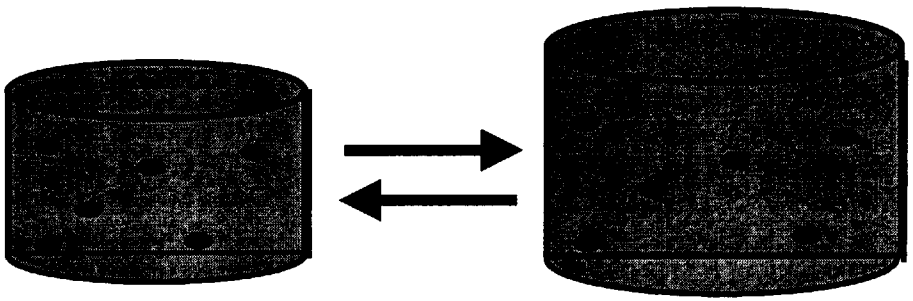
Vapor A



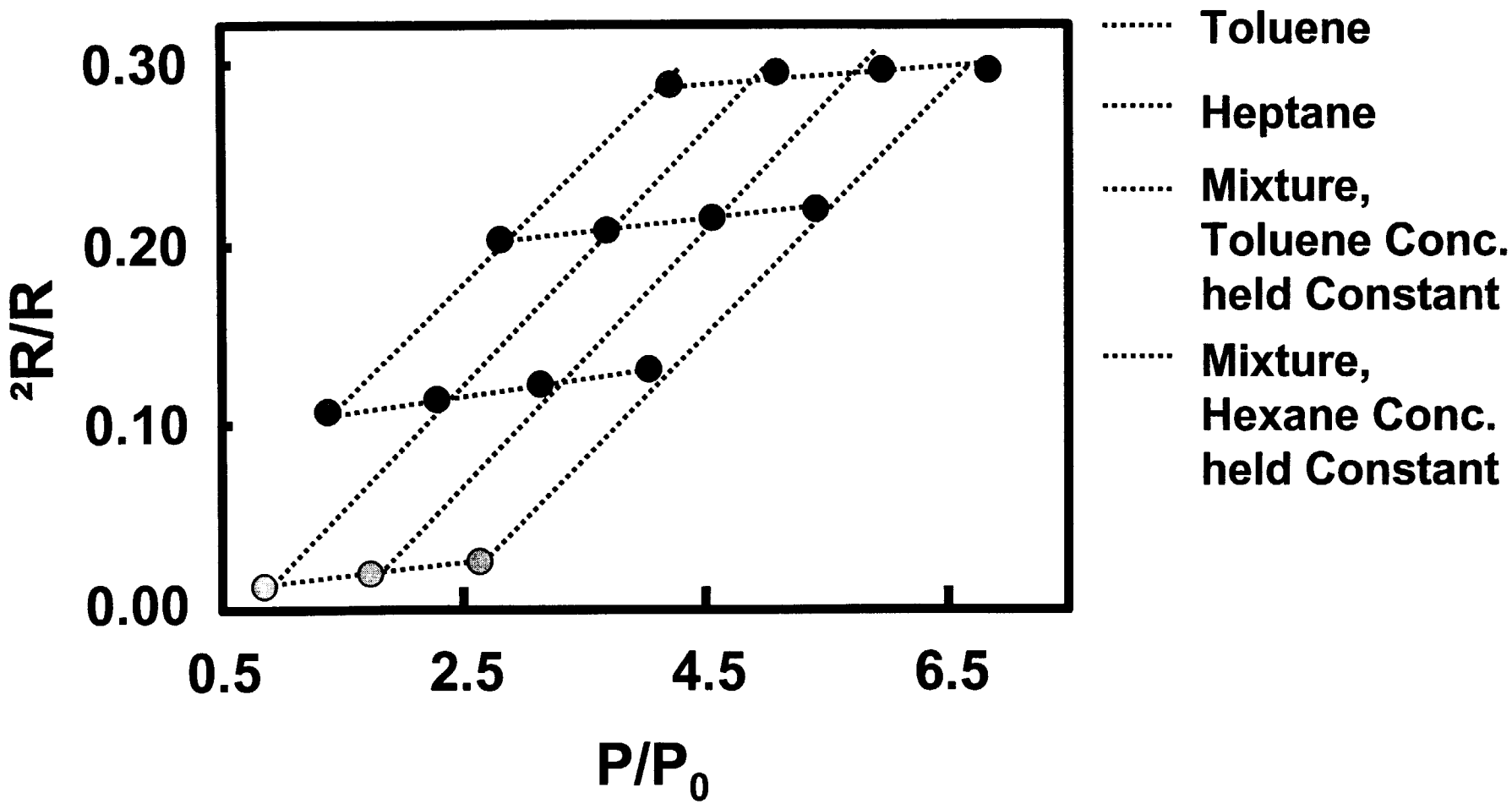


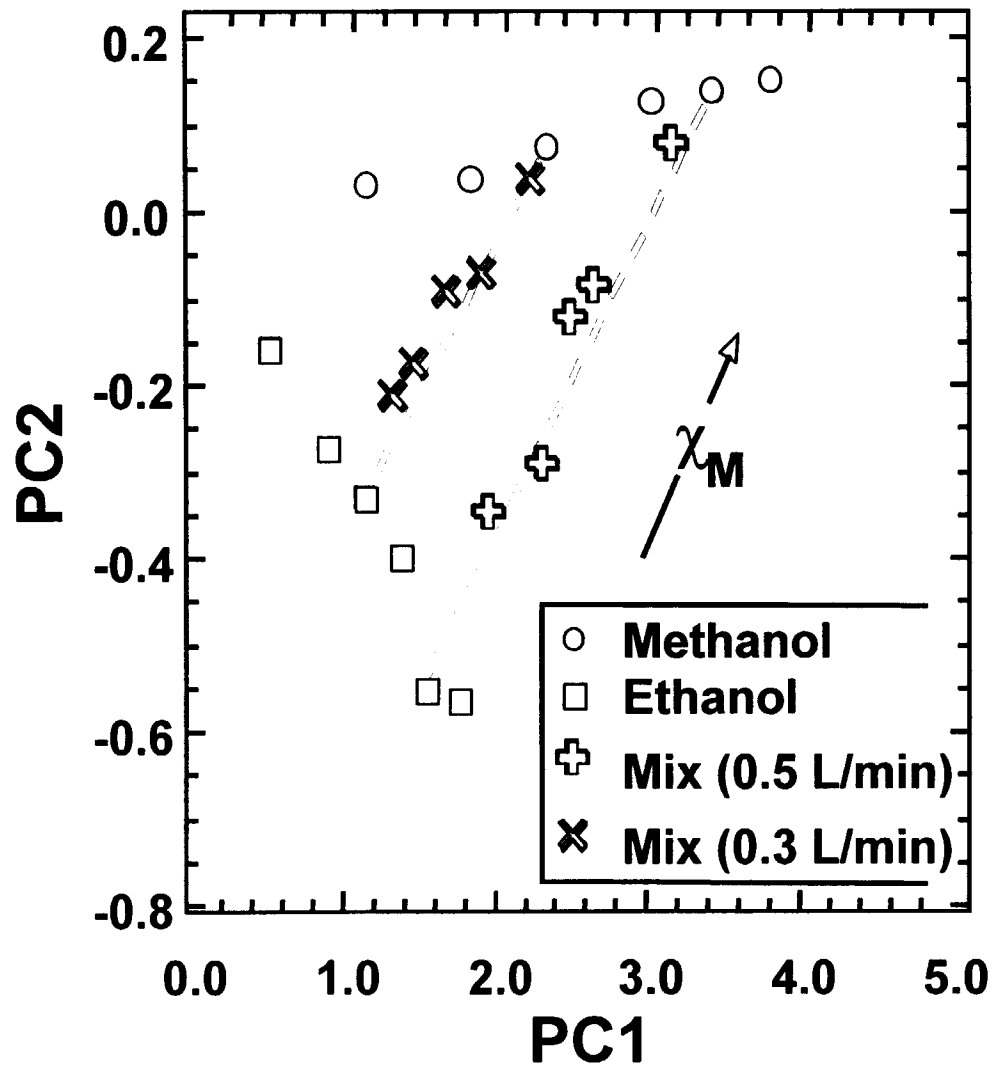
Vapor B





Heptane /Toluene Mixtures



Poly(styrene-co-allyl alcohol)/carbon black

Methanol/Ethanol Mixtures