Comparative Studies of Gold Nanoparticles as Chemical Sensing Materials: Electronic Tongue vs. Electronic Nose, Year Three

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This is a continuation project (Year 3). Two types of simple, cost-effective, reusable electrochemical sensors were created with functionalized gold nanoparticles (~1.6 nm core diameter) for the detection of toxic metal ions in water (electronic tongue) and gas/vapors in the air (electronic nose). The functionalization of gold nanoparticles was achieved by ligand exchange reactions with crown ether thiols (electronic tongue) or polymeric/aliphatic thiols (electronic nose). The sensing platforms were prepared by either self-assembly (electronic tongue) or drop-casting (electronic nose) gold nanoparticles on the interdigitated array electrode. The electronic tongue can simultaneously detect cadmium, mercury, lead, and beryllium at 0.1 – 2.6 ppb levels, while the electronic nose can simultaneously detect carbon monoxide, ethanol, and dichloromethane at 5.0 – 12.5 kPa levels. The performance of electronic tongue and nose was comparatively analyzed by looking at their detection limits, sensitivities, selectivities, and dynamic ranges. Compared with the previous year's electronic tongue (a non-linked film by drop-cast), the current year's electronic tongue (a linked film by self-assembly) showed better sensitivity, selectivity, and stability but similar detection limits and narrower dynamic range. The electronic tongue displayed better sensitivity and selectivity than the electronic nose. The response of electronic nose was less linear than that of electronic tongue. Based on the observed data analysis, it was concluded that (1) gold nanoparticles are versatile materials for chemical sensing, (2) the self-assembly technique is preferred to develop a better electronic tongue, and (3) the electronic tongue provides more reliable data than the electronic nose.

Awards Won:

Second Award of $2,000

Serving Society Through Science: First Award of $500