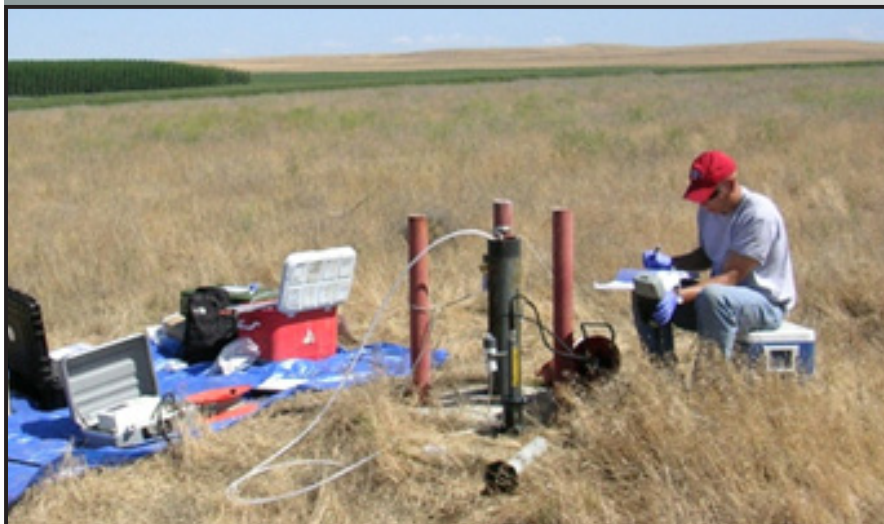# Functionalized Gold Nanoparticles for Rapid, Ultra-sensitive Detection of Environmental Pollutants

UT-B ID 200601675



## Technology Summary

A rapid, highly sensitive, inexpensive method to detect and identify specific hazardous environmental pollutants has been invented by ORNL researchers. The method uses gold nanoparticles, modified and positively charged by an amine group, to identify hazards such as perchlorates, nitrates, and some radioactive materials in as little as one minute of real time. Because of its high stability, specificity, and sensitivity to these materials, the technique and substrate reagent can be used for rapid, in-situ monitoring.

Perchlorate, a chemical that can have serious health effects, has been detected in ground water, surface water, soils, and plants. Currently, perchlorate detection is performed through ion chromatography or IC-mass spectrometry, a process that requires lengthy sample preparation and analytical time in a laboratory. The new ORNL method for surface enhanced Raman spectroscopy (SERS) involves synthesizing gold metal nanoparticles that are modified with specific amine groups. The method can be used in the field when accompanied by portable Raman spectroscopy.

The technique is not only sensitive but highly specific because of the unique Raman vibrational bands of perchlorate and other environmental pollutants. The gold nanoparticles are surface modified with amine groups such as 2-(dimethylamino) ethanethol or trimethylaminethiol and then are used to interact with and thus identify specific pollutants of interest such as perchlorate, nitrate, or a radioactive sample such as uranium. The intensity of the scattering signal is measured and the amount of pollutant material present is detected.

## Advantages

- Greatly reduced analytical time and cost
- High sensitivity for routine monitoring of perchlorate
- Good selectivity
- In situ, real-time monitoring in the field with no necessary pretreatment of samples
- Rapid turnaround of data and decision making

## Potential Applications

- Monitoring pollutants, such as perchlorate
- Estimated market value (as a monitoring device) could be in multi-million dollars when the SERS reagent and substrate materials are coupled with portable Raman systems (such as those marketed by EnWave Optronics Inc. and Ocean Optics)

## Patent

Baohua Gu. *Functionalized Gold Surface-Enhanced Raman Scattering Substrate for Rapid and Ultra-Sensitive Detection of Anionic Species in the Environment*, U.S. Patent 7,989,211, issued August 2, 2011.

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