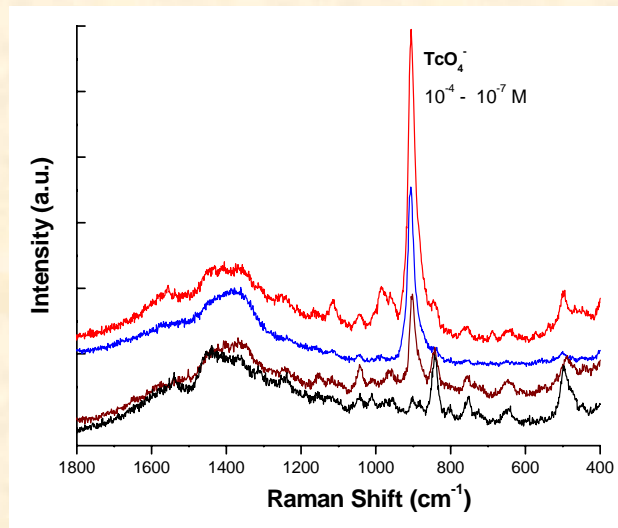


For the first time, surface-enhanced Raman spectroscopy is made capable of detecting radioactive technetium (Tc)

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Sponsor: DOE/OBER and ORNL/SEED

- **A new tool - surface enhanced Raman spectroscopy (SERS), is developed and demonstrated for detecting radioactive technetium (Tc) and its speciation at low concentrations.**
- **The technique requires a small sample volume (<5 μL) but offers molecular fingerprints with a high sensitivity.**
- **SERS technique can distinguish different oxidation states or species of Tc such as oxidized, reduced and complexed Tc, which are of critical importance in determining Tc transport and fate in the environment.**
- **The only technique which may potentially be made possible for rapid, *in situ* field monitoring of Tc and its speciation by coupling with a portable Raman spectrometer.**



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Technetium (Tc) is an important radionuclide of concern and, until now, its detection and speciation analysis primarily rely on liquid scintillation counting, gel chromatography, extended X-ray absorption fine structure and near-edge spectroscopy (EXAFS and XANES).

For the first time, we report that surface-enhanced Raman spectroscopy (SERS) is capable of detecting pertechnetate (TcO_4^-), at $\sim 10^{-7}$ M concentration levels. The technique also allows the detection of various species of Tc such as oxidized Tc(VII), reduced and possibly complexed Tc(IV) species using surface-functionalized gold nanoparticles as a SERS substrate. The primary Raman scattering band of Tc(VII) occurs at about 904 cm^{-1} , whereas reduced Tc(IV) and its humic and EDTA complexes show scattering bands at about 866 and 870 cm^{-1} , respectively. Results also indicate that Tc(IV)-humic complexes are unstable and can re-oxidize to TcO_4^- upon exposure to oxygen. Our results thus demonstrate that SERS can offer a new, complementary tool and opportunity in studying Tc and its speciation and interactions in the environment at low concentrations.

Reference: Gu and Ruan, 2007. *Anal. Chem.* (in press).