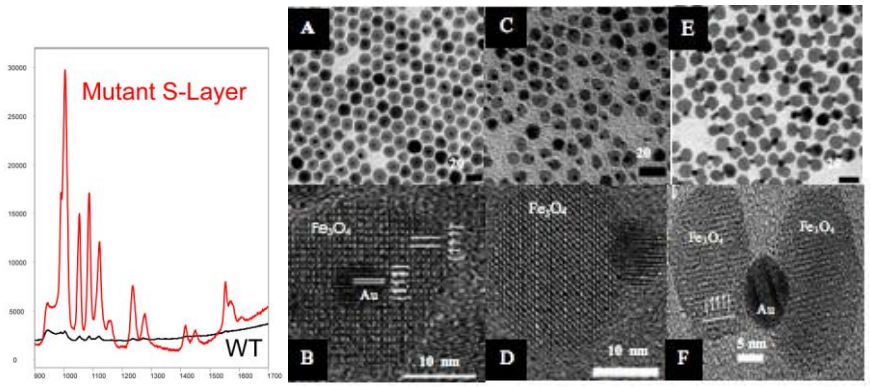
Stand-off SERS Detection of Pesticides and Agriculturally Important Analytes Using Nanoparticles

The overall goal here is to establish a stand-off detection system for remote sensing of agriculturally important analytes. The *nanoparticle sentinel system* is based upon a nanoparticle component which generates a signature Raman scattering spectrum when the analyte is bound. Nanotechnology provides the tools for creating materials that exploit unique phenomena at the nanoscale. Dr. Carl Batt of Cornell University has harnessed two nanoscale properties; (i) molecular target capture and (ii) quantum enhancement of molecular spectral fingerprints. The information generated by these nanoparticle sentinels allows farmers to more accurately manage crops and to more effectively apply supplements to their fields. The significant accomplishments have been obtained in developing target specific binding nanoparticles. In this effort, a number of different gold nanoparticles are tested whose size and shape varies to include roughened spherical particles and nanostars. The differences in size and shape have an effect on the spectrum obtain and the sensitivity and specificity.

The effort delivers a practical solution to real-time analysis of distribution and fate of pesticides using two components. One component of the *nanoparticle sentinel system* is a SERS active nanoparticle that is able to complex with the target pesticide. The other component is a stand-off detection instrument that can be used in the field for detecting SERS spectra from these nanoparticles. The nanoparticles are designed and optimized laying a foundation for other pesticides and other agents that are applied in the field. **While we are concentrating on one model agent, the approach should be generally applicable and requires the development and optimization of the binding chemistry.** In combination, these components will provide a real-time monitoring of pesticide application and fate.



SERS spectra of nanoparticles arrayed on protein layers (left) and TEM images of a series of spinels which have iron and gold components.

Strickland, A.D. and Batt, C.A. (2009). Detection of carbendazim by surface enhanced Raman scattering using cyclodextrin inclusion complexes on gold nanorods. Anal. Chem. **81:** 2895-2903