Nanoparticles (NPs) exhibit unique surface properties and require well-controlled surface properties to achieve optimum performance in complex environments.

The Molecular Analysis Facility (MAF) provides instrumentation and professional expertise for rigorous and detailed characterization of NPs with complementary techniques.

MAF instrumentation that valuable information about NPs includes transmission electron microscopy (TEM), atomic force microscopy (AFM), x-ray photoelectron spectroscopy (XPS), time-of-flight secondary ion mass spectrometry (ToF-SIMS) and sum frequency generation (SFG) vibrational spectroscopy.

We use TEM and AFM to determine the size, shape and distribution of NPs (quantum dots, gold NPs, etc.). XPS is used to determine the composition, chemical species and thickness of overlayers on NPs. ToF-SIMS and SFG provide molecular structure information about species present on the NP surface. Together these methods provided a detailed understanding of the NP structure and chemical composition.

For more information, contact the Molecular Analysis Facility:

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### Nanoparticle Analysis Techniques

#### CASE STUDY

**TRANSMISSION ELECTRON MICROSCOPY**

- **Nanoparticle Size and Shape**
- **Chemical Composition of Nanoparticle Surface**

**Chemical Species Determination**

**ToF-SIMS**

Above: The data shows a series of peaks characteristic of the molecule attached to the gold NP.

**Chemical Composition of Nanoparticle Surface**

**XPS**

Above: XPS-determined elemental composition of the outer ~ 10 nm of functionalized 14nm gold NPs (red), 40nm gold NPs (blue) and flat gold surface (green).

**Nanoparticle Size and Shape**

**TRANSMISSION ELECTRON MICROSCOPY**

- Left: 7nm cadmium selenide/cadmium sulfide/zinc sulfide quantum dots
- Left: 14nm gold nanoparticles