Flat Gold Nanoparticles: Atomically-Flat Substrates for Surface Science and Molecular Plasmonics

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Individual molecules, nanoparticles, and their assemblies are being explored as building blocks for proposed new electronic and photonic devices. Despite intense work in this area many fundamental issues remain unresolved. My group's focus has been to investigate the application of flat gold nanoparticles (FGNPs) as model systems for molecular plasmonics.

We have developed FGNPs as atomically-flat bench-top-friendly nano-platforms suitable for high resolution scanning tunneling microscopy (STM) of molecular monolayers. These surfaces are also optically resonant with well-defined plasmon modes to facilitate controlled coupling of light to the molecular monolayer. The FGNPs are solution-grown single-crystal gold platelets 10-50 nm thick and lateral size 50-5000 nm. These surfaces also can be cleaned and annealed to remove contaminants and to modify the atomic terrace structure.

Because our studies are inherently single nanoparticle, each FGNP must be treated as an individual. In order to fully characterize individual nanoparticles, we have developed an addressed grid system that allows facile multi-platform measurements. These include optical microscopy, SEM, AFM, NSOM, and single-nanoparticle spectroscopy. I will show how this methodology allows us to think about single nanoparticle measurements in new ways.