The localized surface plasmon resonances (LSPRs) of noble metal nanostructures have found applications in a wide range of areas, such as imaging, sensing, nanomedicine (photothermal therapy and controlled drug delivery), enhancement of linear and nonlinear optical signals (Raman, fluorescence, high-harmonic, solar energy harvesting, two-photon excitation, photolithography, and upconversion), optics and optoelectronics (subwavelength waveguiding, photoswitching, optical data storage, spasers, optical tweezers, and metamaterials). Gold nanocrystals are chemically stable and biologically compatible. They exhibit extraordinary plasmonic properties. In the past several years, we have carried out intensive experimental and theoretical work to understand the plasmonic properties of gold nanocrystals and explore their technological applications. We have made contributions in

1. synthetic tailoring of the plasmonic properties (plasmon resonance wavelengths, absorption/scattering cross sections, local electric field enhancements) of gold nanorods,
2. preparation of hybrid nanostructures involving gold nanocrystals,
3. refractive index sensitivities of variously-shaped gold nanocrystals,
4. assembly of gold nanorods in chains and three-dimensional, large-area, highly ordered superstructures,
5. plasmon coupling among gold nanocrystals,
6. plasmon-enhanced fluorescence on gold nanorods,
7. photothermal conversion efficiencies of variously-shaped gold nanocrystals, and
8. plasmonic–molecular resonance coupling.

In this presentation, I will focus on plasmon-enhanced fluorescence, plasmonic and molecular resonance coupling, and refractive index sensitivities of variously-shaped gold nanocrystals.