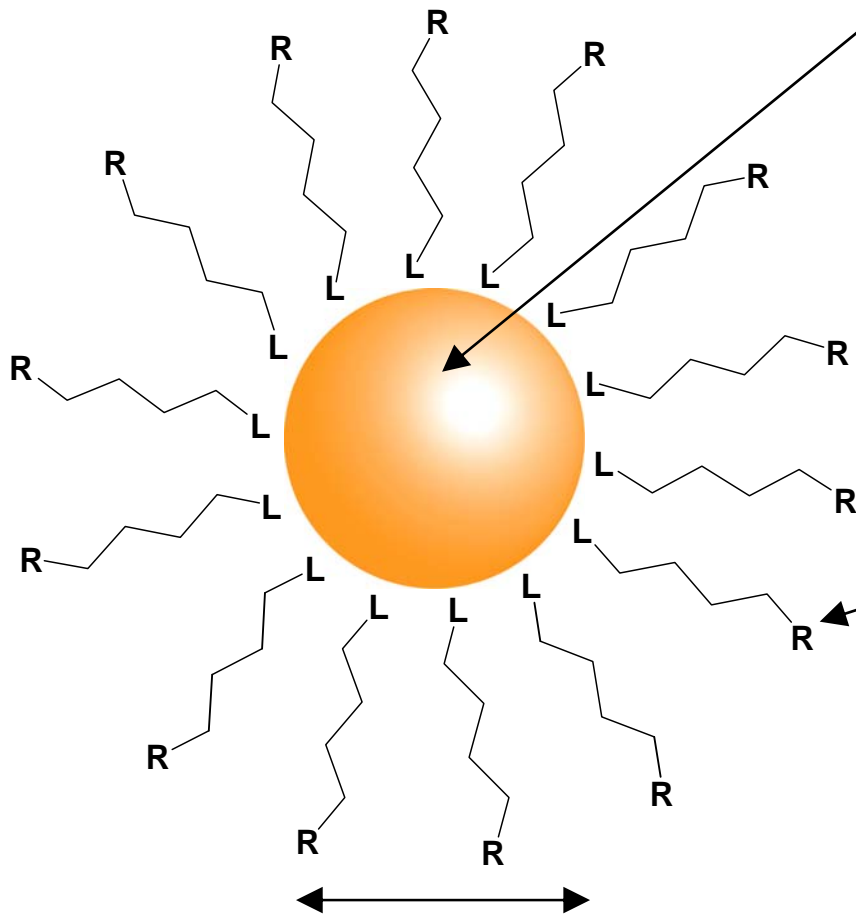


Monolayer-Protected Nanoparticles

Joseph B. Tracy



NC STATE UNIVERSITY
Materials Science
and Engineering



core diameter \approx 1 - 20 nm

Inorganic core with size-tunable phenomena:

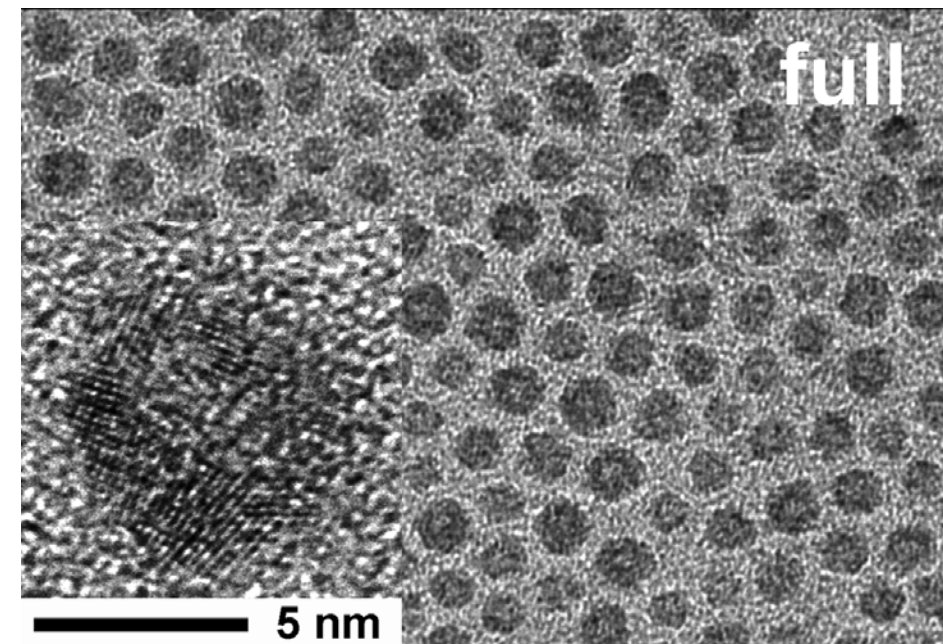
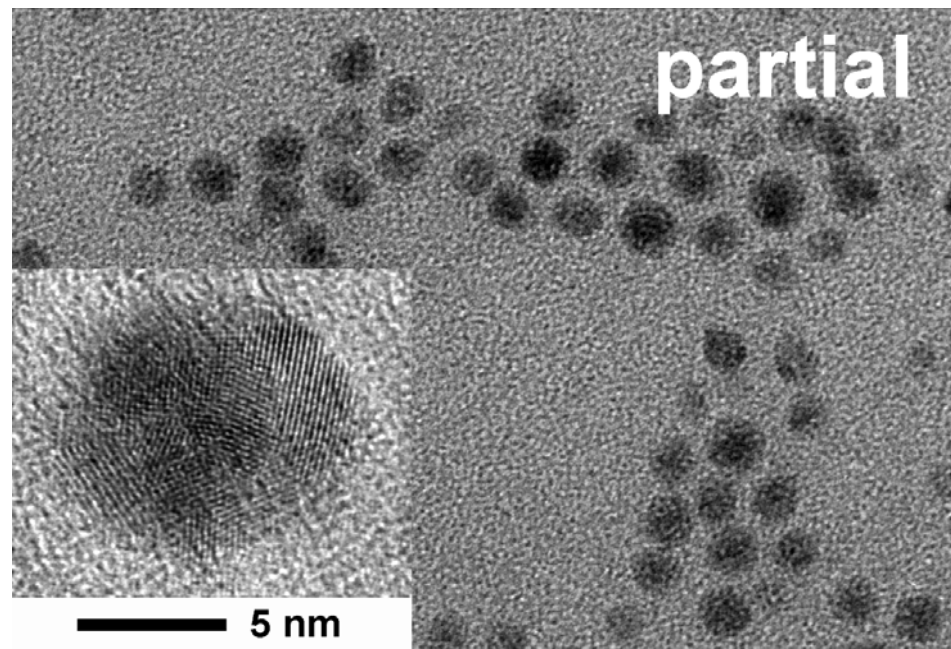
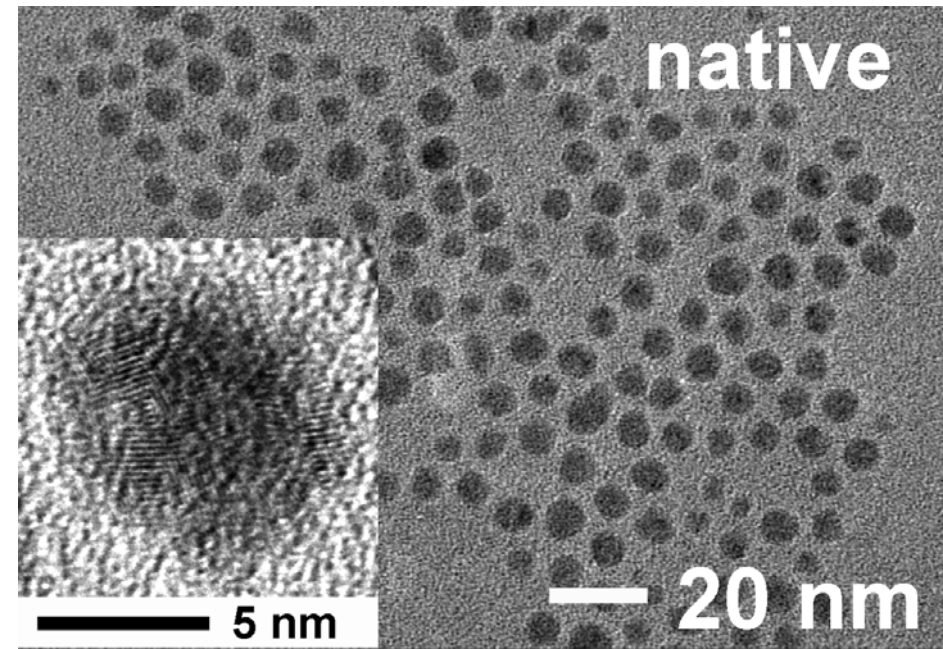
- **magnetic NPs**
superparamagnetism
- **semiconductor NPs**
quantum confinement
- **metallic NPs**
plasmon resonance
quantized charging

Ligand monolayer and functional groups (R):

- **solubility**
- **patterning**
- **coupling / bioconjugation**

High surface area-to-volume ratio

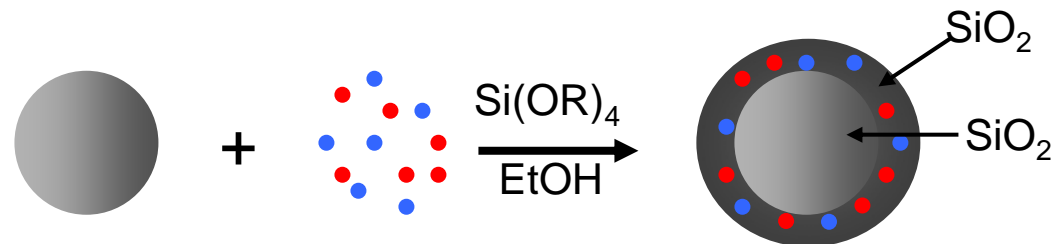
Oxidized cobalt nanoparticles



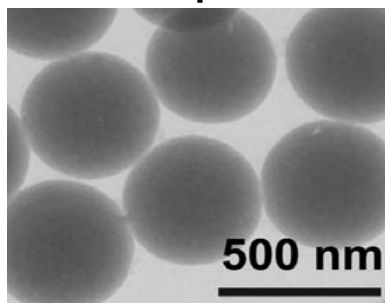
J.B. Tracy, et al., *Phys. Rev. B* **72**, 064404, (2005).

J.B. Tracy, M.G. Bawendi, *Phys. Rev. B* **74**, 184434, (2006).

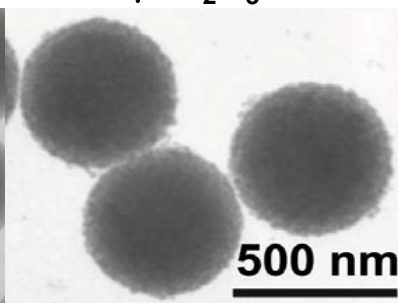
Magnetic nanoparticles and quantum dots in silica microspheres



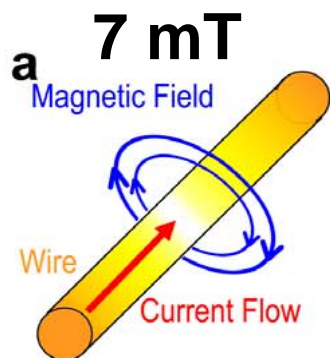
bare microspheres



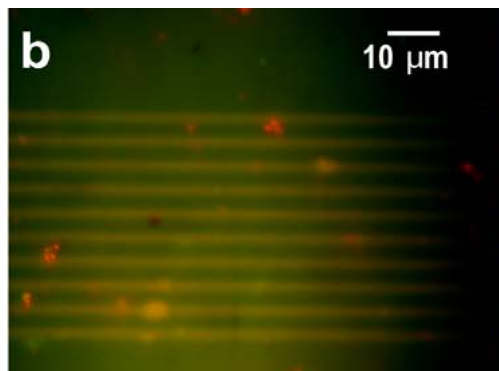
with $\gamma\text{-Fe}_2\text{O}_3$ and CdSe



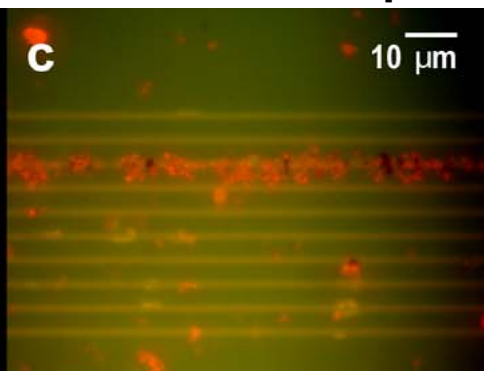
Motion control on an array of gold wires



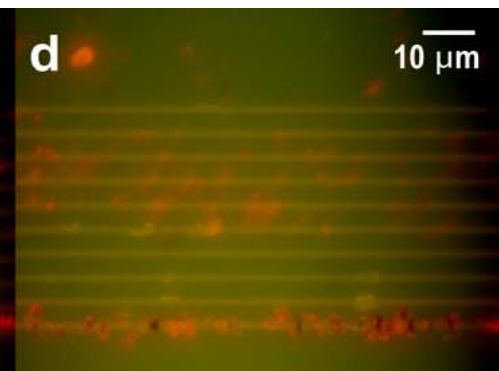
all bars off



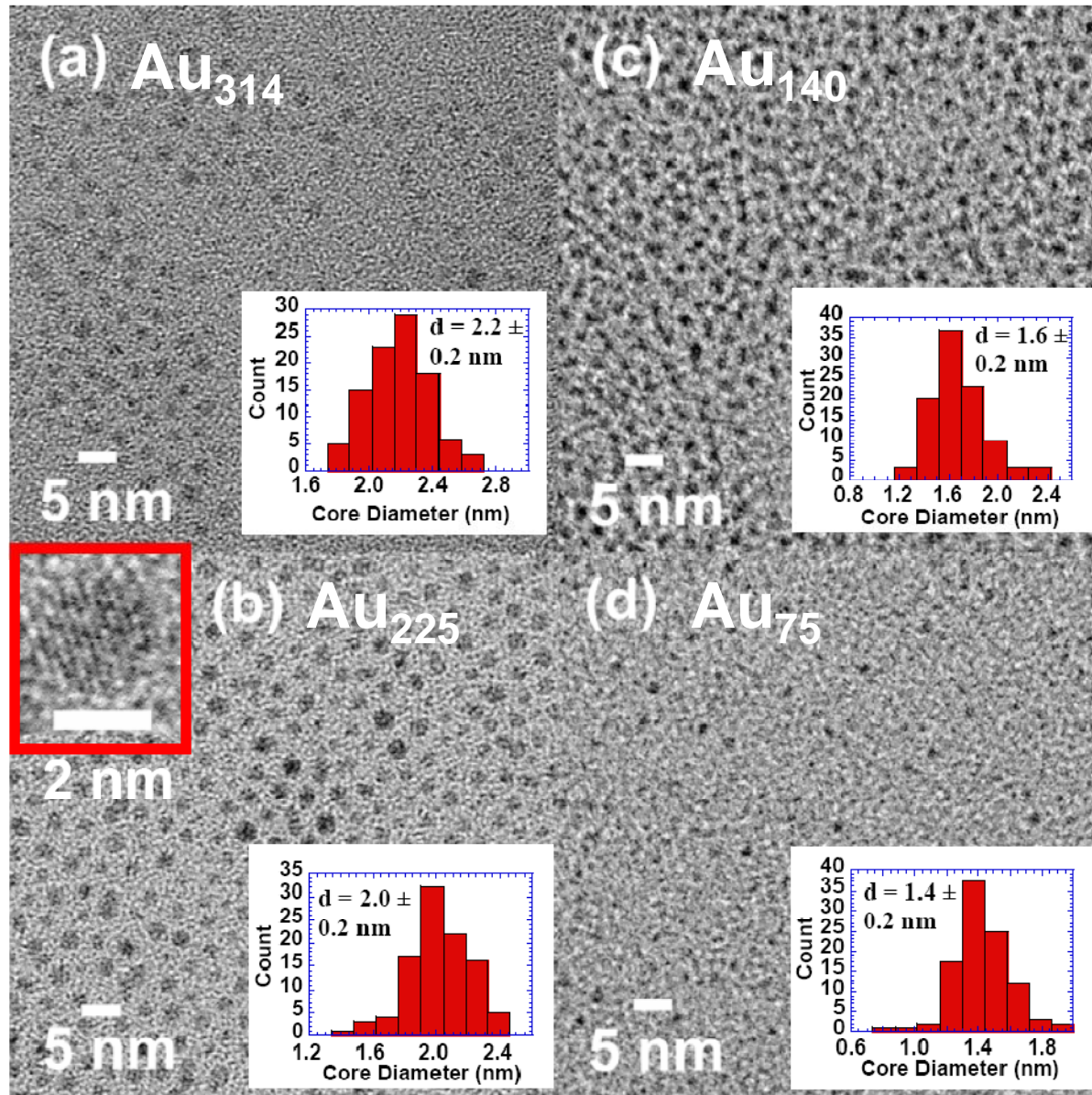
third bar from top on



bottom bar on



Small, thiolate-stabilized gold nanoparticles



Current work at NC State: Magnetic and Metallic Nanoparticles

Exchange biasing and exchange spring magnets

Integration with plasma processing and thin films

Incorporation into active (surface-grafted) polymer systems

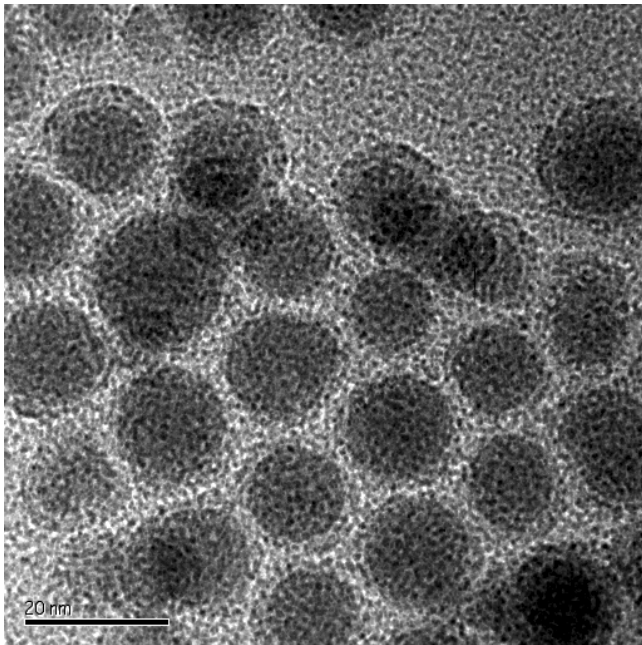
Ligand removal for further surface chemistry: biosensing, SERS, catalysis

Nanoscale, hybrid (thin film, conducting oligomer, nanoparticle) spin valves

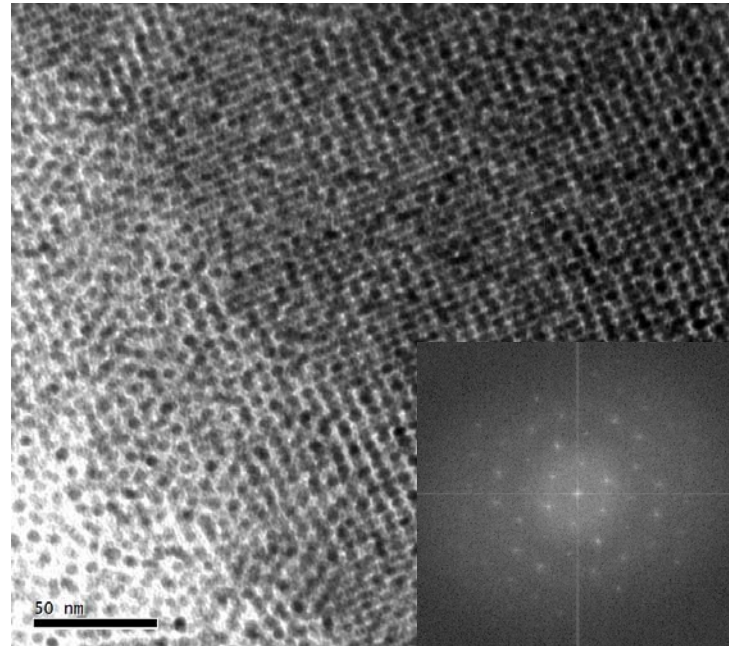
Janus, asymmetrically coated nanoparticles

Compositions: Co/CoO, Ni/NiO, Fe₂O₃, Fe₃O₄, ferrites, Au, Ag, CdSe

Ni(core)/NiO shell nanoparticles



FePt nanoparticles



(Dr. Junwei Wang)

We seek collaborations in all areas, including biology, medicine, and toxicology!