Gold Nanocluster Electronics and Sensors

NRL Electronics, Chemistry and Bio-Molecular Sciences

Presenter: Dr. Mario Ancona, NRL Electronics Division

Why are gold nanoclusters interesting?
- Easily prepared (first in ancient times).
- Surface chemistry well-known and easy to work with:
  - Control over assembly on surfaces.
  - Control over sensitivity/selectivity to chemical vapors.
- Electrical properties: potentially very useful:
  - Of “molecular” size yet act as simple metals.
  - Quantum mechanical tunneling.
  - Ultra-small capacitance => Coulomb blockade at 300K.

Why should the Navy/Marine Corps be interested?

How are devices/sensors fabricated from gold nanoclusters?
- Pre-Patterned Si-SiO₂ Substrate
- Self-Assembly Chemistry

Gold Nanocluster Electronics

Basis of Operation: Coulomb Blockade
- Ultra-small size of nanoclusters implies ultra-small capacitance:
  - Room temperature operation.
  - Strong nonlinearity at useful voltage.
  - Nonlinearity allows:
    - Switching: Single-electron transistor.
  - Potential for ultra-small-size and ultra-low-power electronics.

Gold Nanocluster Sensors

Basis of Operation: Tunneling

Chemiresistor Scaling

Sensor Characteristics

The Future

Novel Assembly Schemes

The Future