Nanotechnology Science

Lecture by

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Biography

B.Sc. from Ain Shams University, Cairo, Egypt; Ph.D., Florida State University. Prof. Elsayed has been granted numerous prestigious awards as a recognition of his outstanding scientific research: The ACS Langmuir National Award in Chemical Physics, 2001; the ACS Local Section Awards; the Northeast Richards Medal; the ACS Florida Section Award; the ACS California Section Award; the Southern California Section (Tolman) Award; the Eastern Tennessee Linde Award; and the 1990 King Faisal International Prize in Sciences. Prof. Elsayed is also an elected member of the US National Academy of Sciences; elected fellow of the American Academy of Arts and Science (AAAS), and the American Physical Society; and an associate member of the Third World Academy of Sciences.

Abstract

1. Nanoscience

Synthesis and Study of the Properties of Nanomaterial of Different Shapes

The type of electronic motion in matter determines its property and applications. This motion is determined by the forces acting on the electrons, which in its turn determines the space in which they are allowed to move. One expects that if we reduce the size of material to below its naturally allowed characteristic length scale, new properties should be observed which alters by changing size or shape of the material. These new properties are different from that of the macroscopic material as well as of their building blocks (atoms or molecules). This occurs on the nanometer length scale. Our group is studying the properties of these nanometer materials.

The properties examined are:

- Ultrafast electron-hole dynamics in semiconductor nanoparticles
- Shape control synthesis and stability of metallic nanoparticles
- The enhanced absorption and scattering processes, the electronic relaxation and Photothermal properties of gold and silver nanocrystals of different shapes.

2. Nanotechnology, Potential Use of Nanoparticles in:

a) Nanomedicine: Diagnostics and Selective Photothermal Therapy of Cancer

When gold or silver nanoparticles are conjugated to cancer antibodies, the cancer cells are covered with those nanoparticles, and every cell can be detected under a simple microscope due to their "strongly" enhanced scattering properties. Furthermore, the fact that these nanoparticles absorb light strongly, and this light is converted rapidly into heat, allows for the destruction of cancer cells selectively at such very low laser energies not sufficient to harm the surrounding healthy cells.

b) NanoCatalysis: Shape Dependent Catalysis

Due to their large surface to volume ratio, nanoparticles are expected to be good catalysts. Since different shapes of nanoparticles made of the same material have their surface atoms arranged differently, one expects them to have different catalytic properties.

c) NanoPhotonics: Modulating the Optical Properties of Gold and Silver (Plasmonic) Nanoparticles by their Coherent Lattice Motion

The strong surface plasmon absorption frequency of gold and silver nanoparticles depends on their electron density (as well as on their dielectric constant and that of its environment; their shape, and size). As their lattice oscillates, the electron density changes and thus their absorption frequency (their color). Using femtosecond lasers, the electrons in these nanoparticles can be excited, which rapidly heats the lattice, leading to its coherent oscillations (vibrations).