SHORT ANSWERS

The quantum size effect

The quantum size effect is most pronounced for semiconductor nanoparticles, where the band gap increases with a decreasing size, resulting in the interband transition shifting to higher frequencies.

(When the size of a nanocrystal (i.e. a single crystal nanoparticle) is smaller than the de Broglie wavelength, electrons and holes are spatially confined and electric dipoles are formed, and discrete electronic energy level would be formed in all materials. Similar to a particle in a box, the energy separation between adjacent levels increases with decreasing dimensions)

Microporous ,Mesoporous , and Macroporous materials

According to the classification made by IUPAC, porous solids can be grouped into three categories, depending on their pore diameter:

microporous ($d < 2$ nm), mesoporous (2 nm $< d < 50$ nm), and macroporous ($d > 50$ nm) materials.

(Almost all of zeolites and their derivatives are microporous, whereas surfactant templated mesoporous materials and most xerogels and aerogels are mesoporous materials.)

Langmuir-Blodgett films (LB films)

Langmuir-Blodgett films (LB films) are monolayers and multilayers of amphiphilic molecules transferred from the liquid-gas interface (commonly water-air interface) onto a solid substrate .

The amphiphile

The amphiphile is a molecule that is insoluble in water, with one end that is hydrophilic, and therefore is preferentially immersed in the water and the other that is hydrophobic and preferentially resides in the air or in the nonpolar solvent. A classical example of an amphiphile is stearic acid, $C_{17}H_{35}CO_2H$.

Superlattices

Superlattices are specifically referred to as thin film structures composed of periodically alternating single crystal film layers; however, it should be noted that the term superlattice was originally used to describe homogeneous ordered alloys.

Self-assembly

Self-assembly is a generic term used to describe a process that ordered arrangement of molecules and small components such as small particles occurred spontaneously under the influence of certain forces such as chemical reactions, electrostatic attraction and capillary forces.

Electrospinning

Electrospinning (electrostatic fiber processing) technique has been originally developed for generating ultrathin polymer fibers. Electrospinning uses electrical forces to produce polymer fibers with nanometer-scale diameters.

(Electrospinning occurs when the electrical forces at the surface of a polymer solution or melt overcome the surface tension and cause an electrically charged jet to be ejected. When the jet dries or solidifies, an electrically charged fiber remains.)

Lithography

Lithography is the process of transferring a pattern into a reactive polymer film, termed as resist, which will subsequently be used to replicate that pattern into an underlying thin film or substrate.

(Photolithography is the most widely used technique in microelectronic fabrication, particularly for mass production of integrated circuit.)

Photolithographic Process

Typical photolithographic process consists of producing a mask carrying the requisite pattern information and subsequently transferring that pattern, using some optical technique into a photoactive polymer or photoresist .

Atomic layer deposition (ALD)

Atomic layer deposition (ALD) is a unique thin film growth method and differs significantly from other thin film deposition methods. The most distinctive feature of ALD has a self-limiting growth nature, each time only one atomic or molecular layer can grow.

(ALD offers the best possibility of controlling the film thickness and surface smoothness in truly nanometer or sub-nanometer range)

Nernst equation:

The electrochemical potential of a metal electrode, E, is given by the Nernst equation:

$E = Eo + (R_gT/n_i F) \ln a_i$ where Eo is the standard electrode potential, or the potential difference between the electrode and the solution, when the activity, a_i of the ions is unity, F, the Faraday's constant, R,, the gas constant and T, temperature.

The Nernst equation represents an equilibrium state.

Zeolites

Zeolites are crystalline aluminosilicates , has a three-dimensional framework structure with uniformly sized pores of molecular dimensions, typically ranging from ~0.3 to 1 nm in diameter, and pore volumes vary from about 0.1 to 0.35cc/g.

(There are 34 naturally occurring zeolites and nearly 100 synthetic type zeolites.

A zeolite spectrum of applications, and examples include catalysts, adsorbents and molecular sieves.)

Zeolites are tectoaluminosilicates with a formal composition $M_{2/n}0.Al_2O_3.xSi0_2.yH_2O$ (n = valence state of the mobile cation, M^+ and x ≥2), in that they are composed of TO4 tetrahedra (T = tetrahedral atom, i.e. Si, Al), each oxygen atom is shared between adjacent tetrahedral.

Molecular Electronics

In molecular electronics, single molecules are expected to be able to control electron transport, which offers the promise of exploring the vast variety of molecular functions for electronic devices, and molecules can now be crafted into a working circuit .

When the molecules are biologically active, bioelectronic devices.

Nanorobots or Nanobots.

Nanobots are nanoscale devices , would be programmed to perform specific functions and be remotely controlled, so that they can travel and perform desired functions inside the human body.

These nanobots have the potential to serve as vehicles for delivery of therapeutic agents, detectors or guardians against early disease and perhaps repair of metabolic or genetic defects.

Gold Catalyst.

Bulk gold is chemically inert and thus considered to be not active or useful as a catalyst. However, gold nanoparticles can have excellent catalytic properties .

Band gap engineering

Band gap engineering is a general term referring to the synthetic tailoring of band gaps with the intent to create unusual electronic transport and optical effects, and novel devices. Obviously, most of the devices based on semiconductor nanostructures are band gap engineered quantum devices.

Electron Emitters

Standard electron emitters are based either on thermionic emission of electrons from heated filaments with low work functions or field emission from sharp tips.

(The latter generates monochromatic electron beams; however, ultrahigh vacuum and high voltages are required. Further, the emission current is typically limited to several microamperes.)

Carbon fibers, typically 7 pm in diameter, have been used as electron emitters; Carbon nanotubes have high aspect ratios and small tip radius of curvature.

Photoelectrochemical cells

Photoelectrochemical cells (photovoltaic cells or solar cells) are used to convert solar energy into electrical power.

Photoelectrochemical devices consisting of silicon-based pn junction material and other heterojunction material most notably indium-gallium-phosphidel gallium-arsenide and cadmium-telluride/cadmium-sulfide for efficient light conversion.

(Nanostructures are advantageous for photoelectrochemical cell devices for high efficient conversion of light to electrical power due to its large surface area at which photoelectrochemical processes take place.)

Photonic crystals

Photonic crystals are periodic optical structure that can control the flow of light.

Or

Photonic crystals are periodic dielectric structures that have band gap that forfids propagation of a certain frequency range of light.

Organic-inorganic hybrids

Organic-inorganic hybrids are materials in which organic and inorganic components interpenetrate each other in nanometer scale and both form percolated three-dimensional networks commonly by sol-gel processing.

Such organic-inorganic hybrids have also been termed Ormosils (organically modified silicates.

Class I hybrids

Class I hybrids can be considered as molecular scale nanocomposites where organic components are physically trapped in an inorganic matrix.

Class II hybrids

Class II hybrids comprise organic and inorganic components chemically bonded with each other and truly differ from organic-inorganic nanocomposites.

Class II hybrids can be considered as a huge molecule that links organic and inorganic components through true chemical bonds.

Nanomechanics

Nanomechanics is a branch of nanoscience studying fundamental mechanical,elastic,thermal and kinetic properties of physical systems at the nanometer scale.

Nanorobot

A nanorobot is a tiny machine designed to perform a specific task or tasks repeatedly and with precision at nanoscale dimensions.