EAV

Clase #1

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Nanotechnology: The vision

Nanotechnology has been inspired by great physicist Richard Feynman (Nobel price 1965), who already predicted back in 1959:

"There is plenty room..."

Realm of nanotechnology.

Nanoscience and nanotechnology:

→ to make, measure ...

→ Basic concepts

what's so especial about nanostructures?

- Material properties change and become tunable by size.
- New laws of physics (quantum mechanics) come to play.
- surface starts to dominate the material properties.

Basic concepts

Quantization of Electron Energies in Nanostructures:

According

Example: CdSe Nano - Crystals

- colloidal Nano - Crystals synthesized by chemical means.

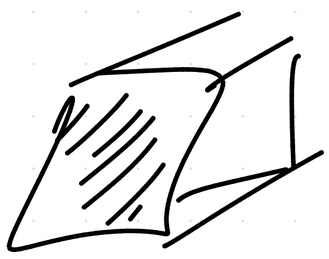
→ strong blue shift of photo-luminescence emission with shrinking nanocrystal size when excited with blue light.

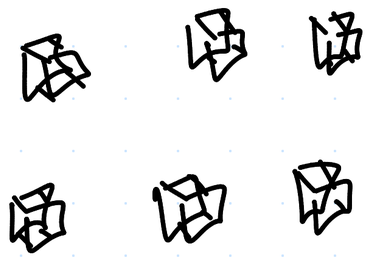
→ surface passivation by organic molecules or core shell structure yields high luminescence efficiency!

~o—o—o Crucial Role of o~o~o surface for NS

Nanostructures exhibit high surface-to-volume ratios:

$A = 6\,cm^2$





$A' = 12\,cm^2$

$A'' = 24\,cm^2$

ratio-scales ~ linearly with physical dimensions!

Nano crystals

10 nm diameter: ~ 5% surface atoms

3 nm diameter: ~ 15% surface atoms

1 nm diameter: ~ 50% surface atoms

Top-down versus bottom-up approach.

1. "Top-down" approach (Lithography)

2. "Bottom-up" approach: sequential writing of nanostructures or atom manipulation.

3. self-organization or self-assembly:

Top-Down Patterning

1. Exposure of photoresist

= Manipulation, writing ....

Bottom-up Nanofabrication

self-assembly and self-organization

- Nucleation, growth, dissolution or attachment of nanoscale structures by:

- Epitaxial growth of thin film heterostructures
- controlled nucleation in solutions or at surfaces.
- self-assembled monolayers
- Catalytic growth of nanowires
- Attachment of molecules / growth of organisms.

- Vapor liquids.

Example: Molecular Beam Epitaxy of nanoislands

self-organization of Quantum Dots

self-organization of Nano-crystals

- current-Trends

(1) combine bottom-up and top-down approaches

(a) Nanostructured templates and circuits provided by top-down litography.

(b) self-assemb...

(2) site-control.