

① What is nanotechnology potential?

→ Nanotechnology is a scientific movement that has the potential to transform the diagnosis and treatment of disease in 21st century. ①

② Explain Top-down and bottom-up approach in detail. ②.5

There are two types of approaches for synthesis of nano-material and fabrication of nano-structure.

- Top-down approach refers to slicing or successive cutting of a bulk material to get nano-sized particles there are two types attrition and ② milling.

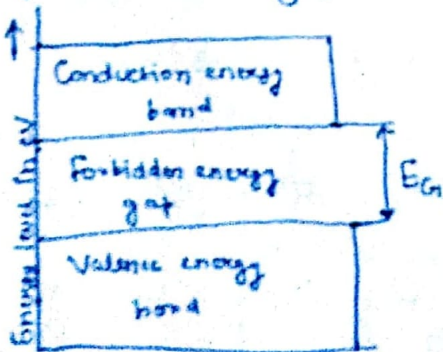
- Bottom-up refers to methods where devices 'create themselves' by self assembly. Chemical synthesis is a good example.

Bottom-up should broadly speaking be able to produce devices in parallel and much cheaper than top-down methods, but getting control over the methods is difficult when things become larger and more bulky than what is normally made by chemical synthesis.

Of course nature has had time to evolve and optimize self-assembly processes that can do wonders.

③ Explain bandstructure of nanoelectronics? ②.5

The e⁻s of an isolated atom are acted upon only by the forces within that atom. However, when atoms are brought together, as in solid, the energy levels that may be the influence of other atoms. Under these conditions, the energy levels of a given material are occupied by the e⁻s merge into bands of energy levels. These two energy bands are valence energy band (or valence band) and conduction energy bands and are separated by an energy gap in which no e⁻ can normally exist, as illustrated. This energy gap is termed as forbidden energy gap.



- ① Write short notes on ① Single e^- tunneling ②
② Carbon nanotubes. ②

Single e^- Tunneling (SET)

A microscopic approach to the theory of small, current biased tunnel junctions is developed.

This approach yields a natural account of the "secondary" quantization of both the single electron (quasiparticle) and Cooper-pair (Josephson) current components.

The theory shows that the current of the single e^- is blocked by their Coulomb interaction at low temperature within a considerable range of the junction voltage. As a result of the blockade, coherent oscillations of the voltage can arise even in the absence of Josephson coupling of the single e^- tunneling (SET) b/w normal metal electrodes. The most significant features of these "SET" oscillations and their coexistence with Bloch oscillations in Joseph junctions are studied in detail.

A SET transistor in the superconducting state.

② Carbon Nanotubes

A Carbon Nanotube is a tube shaped material, made of carbon having diameter measuring on the nano-meter scale.

A nanometer is one billionth of a meter, or about one ten-thousandth of the thickness of a human hair.

The graphite layer appears somewhat like rolled up chicken wire with a continuous unbroken hexagonal mesh and carbon-molecules at the apexes of the hexagons.

Carbon nanotubes have many structures, differing in length, thickness, and in type of helicity and number of layers.

- Carbon nanotubes can be categorized by their structures:
- Single wall Nanotubes (SWNT)
- Multi wall Nanotubes (MWNT)
- Double wall Nanotubes (DWNNT)