

## What is the significance of 'Quantum Mechanics' in nanotechnology?

Phenomena in bulk matter and particles are explained on the basis of classical physics where mass, volume, time and energy are related through exact equations. Hence it is called as deterministic physics. The laws applicable to atomic and sub atomic particles are less certain and hence termed as probabilistic. These are governed by quantum mechanics.

Nanophase matter is made up of only a few atoms and the properties are dominated by the surface atoms. In turn, the surface of these atoms is made up of outer shell electrons. The behavior of the electrons is understood in terms of quantum mechanics. Hence, the principles of quantum mechanics, as applied to electrons, provide an important basis for interpreting nano-scale phenomena.

The following are the principles of quantum mechanics applied to electrons:

- Electrons behave as particles as well as waves and exhibit phenomena like interference.
- The energy of an electron can vary only by certain discrete values. Thus the energy levels of the electrons are quantized.
- The position and the momentum of an electron cannot be determined precisely. Higher the certainty in position, the higher the uncertainty in momentum; and vice versa.
- Wavelength of the wave associated with an electron is inversely proportional to its momentum.
- The probability of existence of an electron at a given point in 3-co-ordinate space, at a given time, is described by (the square) of the 'wave function'.

Comprehension of these quantum mechanical concepts will facilitate better understanding of the nano-scale phenomena such as quantum confinement and quantum tunneling.

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