Chapter-17

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Quantum Dot as an effective emerging material in the current scenario

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17.1 Introduction

The modern Ultra High Definition (UHD) television namely QLED TV has shown extreme vibrant colors as if it is happening in real. This has shown the significance of quantum dots in cutting edge technology[i]. Quantum dots (QDs) can be defined as particles of semiconducting nature having a size of very few nanometers. The name “quantum dot” was coined by Alexey Ekimov in 1981.

Zero-dimensional semiconducting quantum dots are dependent on the size and shape of the materials. The melting point depression of quantum dots is a significant phenomenon linked with quantum dots.

Their optoelectronic properties that vary from their bulk counterpart in a large scale. UV irradiation to a quantum dot excites an electron from lower energy to higher energy, especially from the valence band to the conduction level. When the electron that is already excited to the higher-order energy, emits photons known as photoluminescence (PL) by returning to the lowered ordered energy state. Inside quantum dots, quantum confinement of electrons obeys the potential in a box behaviour that leads to the designated name as artificial atoms as it bears a resemblance to the wave-like behavior as if in real atoms. We can alter controllably the number of electrons that helps us to perform experiments in atomic physics much better[ii]. The dimensions and shape of the Quantum dots alter their opto-electronic properties. The quantum dots having nearly the size of 5 nm is capable of emitting red color whereas the quantum dots having size 2 nm approximately can emit blue color. Various characterization of Monodisperse samples of semiconductor quantum dots results in a conclusion that at particle-particle distance 5–100 Å, interactions between dipole-dipole is the primary reason behind the transfer of energy between adjacent quantum dots, and quantum tunneling between the quantum dots leads to photoconductivity[iii].