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Semiconductors between past and present

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Abstract

There is no doubt that the semiconductor contributed very significantly to changing our world in the long run, which made it very necessary to write this article and shed light on the semiconductor between past and present.

Whereas, this article is not intended to teach you semiconductor chemistry and its applications, but it also aims to refresh your memory with everything related to semiconductors from the moment of sunrise to the present day.

As known, people need to communicate with each other in order to meet their daily and professional needs. In the past, the communication process was very difficult and sometimes costly until the emergence of what is known as semiconductors, which in turn opened new purview in the world of communications through its entry into the communication devices industry and computers industry and its ability to processing The data, in turn, facilitated and summarized a very long journey on humans in the field of industry. Today, we are on the beginning of a new sun rise of semiconductor, especially after the emergence of the so-called nanotechnology, where semiconductors have been observed a very large role in the development of this technology, not only but have become Part of the integral ones.

Introduction

Semiconductors are defined as materials that are not well-connected to electricity and are also not considered insulation or another define is a material that has an electrical conductivity between a conductor and an insulator and contain a very small number of free electrons at room temperature, and they behave as insulating materials at room temperatures but when adding impurities to them can then become a good conductor of electricity such Silicon and germanium are the most important semiconductors known in the world and silicon is the main unit on which modern electronics science is built, including Solar cells, transistors and light-emitting diodes (LEDs) and integrated circuit digital and many other applications.

The properties of semiconductors can be understood and explained by the movement of electrons and the holes that electrons leave during their movement and also in a lattice.

The electrical conductivity of the semiconductor increases with increasing temperature, which is a behavior contrary to the behavior of minerals, and devices that made from semiconductor can display useful properties such as passing the current easily in one direction from the other, and show variable resistance, sensitivity to light or heat, The electrical properties of semiconductors can be changed and controlled by adding impurities to them or by applying electric fields or light. The devices that made from semiconductor can be used for energy transfers and amplification.

The mechanism of electrical conductivity in semiconductors occurs through the movement of free electrons and holes, which are collectively known as charge carriers, Adding impurity particles to a semiconducting material, known as (doping), greatly increases the number of charge carriers inside them. When doped semiconductor contain mostly free holes they are called (p-type), and when they contain mostly free electrons they are known as (n-type) (1).

Applications of Semiconductors in Electronic Devices

Semiconductors are known to be materials that conduct electrical current, are easily manageable, and can act as insulators and conductors. These properties have made

semiconductors useful in electronics. Semiconductor devices can be found in almost every commercial product, beginning from the family car to the handy mini calculator. Semiconductor devices are also present in a wide range of industries, including computers, communications, aerospace, manufacturing, agriculture, and health care. Semiconductors have also entered the electronics industry such as, HDTVs / televisions, CD players, mobile phones and computers, MP3 players, have made them smaller, cheaper, faster and more exact, materials (Semiconductors) are usually found in groups II, III, IV, V, VI of the periodic table.

we can summarize The main semiconductor applications as follows:

Wireless Communication, Industrial Electronics, Telecommunications, Robotics, Medical Electronics, Diode lasers, High brightness LEDs, Solid state lighting, large display panels, automotive applications, LCD backlighting, Optical storage, mice, Imaging array sensors: Digital cameras, Flat panel displays: Computers, television, mobile handheld devices, Memories, Global Positioning By Satellite (GPS) (2).

Semiconductor and nanotechnology

Nanotechnology it is the understanding and controlling the materials in a nanoscale (1-100 nm). This technology includes large horizons to include many fields, including electrical and mechanical engineering, chemistry, biological sciences and many other fields. The property that distinguished this technology from the others is the surface area That the materials have when they make in a nanoscale (3,4,5).

The semiconductor and its optical properties {absorption coefficient and refractive index} can be changed, Semiconductor nanomaterials and devices are still in the research stage, but they are hopeful for applications in many fields, such as biosensors, solar cells, light-emitting diodes, nanoscale electronic devices, laser technology, waveguide, super absorbents, components of armor, chemical and packaging films, parts of automobiles, and catalysts, The development of nanotechnology will certainly lead to significant advance in the semiconductor industry, Semiconductor devices include the various types of transistors, solar cells, many kinds of diodes including the light-emitting diode, the silicon controlled rectifier, and digital, Some of the semiconductor nanomaterials such as Si, Si-Ge, GaAs, AlGaAs, InP, InGaAs, GaN, AlGaN, SiC, ZnS, ZnSe, AlInGaP, CdSe, CdS, and HgCdTe etc., exhibit excellent application in laptops, cell phones, mobile terminals, car taillights, computers, palm pilots, pagers, CD players, satellite dishes, TV remotes, fiber networks, traffic signals, and air bags. Most semiconducting materials, such as the II-VI or III-VI compound semiconductors show quantum confinement behavior in the 1-20 nm size range. Here in we describe and discuss the current use of semiconductor nanomaterials and their applications (6).

Semiconductor nanocrystals (NCs) are made from a variety of different compounds. They are referred to as II-VI, III-V or IV-VI semiconductor nanocrystals, based on the periodic table groups into which these elements are formed. For example, silicon and germanium are group IV, GaN, GaP, GaAs, InP and InAs are III-V, while those of ZnO, ZnS, CdS, CdSe and CdTe are II-VI semiconductors (7).

Application of Semiconductor Nanomaterials

When we talk about Semiconductor nanomaterials, we should say they have special physical and chemical properties and distinctive uses, if we compared it with their normal bulk and molecular materials. Narrow and intensive emission spectra, continuous absorption bands, high chemical and photobleaching stability, processability, and surface functionality are among the most likable properties of these materials. The development of "nanochemistry" is reflected in an immense number of publications on the synthesis of semiconductor nanoparticles (8).

For example, the quantum retention effect results in important change in optical properties of semiconductor nanomaterials. The very big [high surface-to-volume ratio], with both physical and chemical properties of the semiconductor has a major effect on their optical and surface properties. As a result, semiconductor nanomaterials have been very important for researcher about 20 years and have attracted significant interest in research and applications in various subjects such as solid-state physics, inorganic chemistry, physical chemistry, colloid chemistry, materials science, and recently biological sciences, medical sciences, engineering. Among the special properties of nanomaterials, the movement of electrons and holes in semiconductor nanomaterials is firstly detected by the well-known quantum confinement, and the transport properties related to phonons and photons are largely affected by the size and geometry of the materials (9-12), The specific surface area and surface-to-volume ratio increase drastically as the size of the material decreases (9, 13).

Parameters like size, shape, and surface can be changed to control their properties for different applications, These properties of semiconductor nanomaterials have a special significant attention in research and applications in emerging technologies like nanoelectronics, nanophotonics, energy conversion, non-linear optics, miniaturized sensors and imaging devices, solar cells, catalysis, detectors, photography biomedicine etc.(14).

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