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Nanosensor Introduction Production Method and It's Applications.

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Abstract:
Nanosensors are rapidly becoming a technology of choice across diverse field .They offer effective anf affordable options for detecting and measuring chemical and physical properties in difficult to reach biological and industrial systems operating at the nanoscale Nanosensors are tiny devices that can detect very small changes in physical, chemical, or biological conditions. They work using nonmaterials, which have special properties at the nanoscale. This paper gives an overview of how nanosensors are made, how they work, and where they are used. Nanosensors are important in many fields such as medicine, environmental monitoring, and food safety. They help in detecting diseases early, checking pollution levels, and ensuring food quality. The paper also discusses some challenges in using nanosensors, like high cost and difficulty in mass production. Overall, nanosensors are a promising technology with many future applications.

Keywords: Nanosensor, nanoparticles, nanomaterial

Introduction:

A nano Sensor is device that detects and responds to physical Chemical or the biological information at nanoscale-typically between & 1 nm to 100 nm. Nanosensors biological, chemical or surgery points used to convey information about nanoparticles to the macros world. These Sensors leverage nonmaterials or nanotechnology to achieve high Sensitivity fast response and the ability to detect extremely small quantities of Substances.

There are several ways proposed to, make nanosensors, including top-down lithography, bottom up assembly and molecular self assembly.

Feature of Nanosensors:-

1. size- operate at the nanometer scale
2. High Sensitivity -can detect minute quantities (even single molecules)
3. Selective detect detection:- Designed to detect Specific Substances.
4. fast response time:- Instantaneous near –instantaneous signal Generation.

Basic parts of Nanosensors:-

1. Sensing element (Nanomaterial):- Detects the target (e.g. gas, molecule, Temperature. e.g carbon nanotubes, graphene. Gold nanoparticles)
2. Transducer: - Converts the detected Signal into Measurable o/p light like electrical current or light.
3. Readout System: - Displays or sends the signal for control. Monitoring or control.

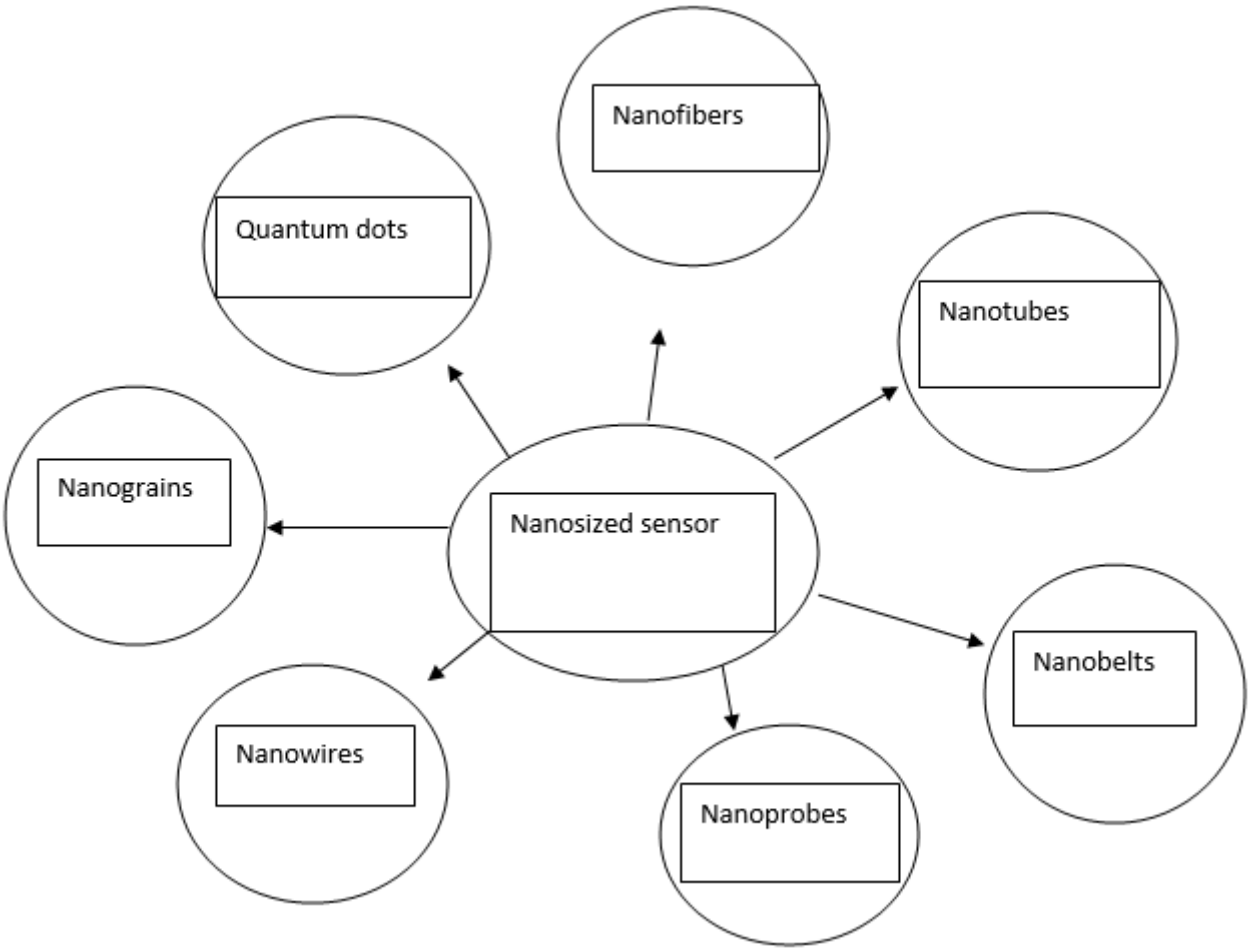
How It Works :-

1. Target molecule come in contact with nanomaterial.
2. The nanomaterials Properties (like resistance) Change.
1. 3 The transducer detects this change
3. A signal (like voltage change) is Shown or recorded.

Types of Nanosensors:-

1) **Chemical nanosensors:-** detect chemical substances like gases ,toxins or pollutants e.g carbon nanotube sensors for detecting No_2, OR Co.
2) **Biological nanosensors (Biosensors):-** Detect biomolecules (proteins DNA glucose etc). e.g. gold nanoparticles based sensors for cancer markers.

Physical Nanosensors: - Measure physical quantities like pressure, temperature or force e.g. nanowire sensors to detect strain or temperature



Existing Nanosensors:-

Currently, the most common mass produced functioning nanosensors exist in the biological world as natural receptors of outside stimulation for instance, sense of smell especially In animals in which it is particularly strong such as dog, Functions using that sense nanosized molecules. Certain plants, too use nanosensors to detect sunlight; various fish use nanesensors in to detect minuscule vibrations surrounding water, and many insects detect sex pheromones using nanosensors. Certain electromagnetic sensors have been use in photoelectric systems these work because the aptly, Photo

sensors easily influenced by light of various wavelengths. Electromagnetic source transfers The energy to the photosensors and energize them into excited state which causes them to release an electron in Semi At that point, it is relatively easy to detect the electricity coming from the sensors, and thus easy to know if the sensors are receiving light.

Most film cameras have used photo sensors at the nanosize for years. Traditional film uses alayer of silver ions that become excited by solar energy and clump into groups as small as four atoms a piece in some cases that scatter light and appear dark on the frame . Various other types of film can be made using similar process to detect other specific wavelengths of light including X- rays infrared and ultraviolet.

Chemical sensors to have been built using nano tube to detect various properties of gaseous molecules. Carbon nanotubes have been used to sense ionization of gaseous molecules while nanotubes made of **Titanium** have been used to detect atmosphere concentration of Hydrogen at molecular level. Many of these involve a system by which nano sensors are built to have specific pocket for another molecule when that particular molecule, and only that specific molecule, fits into the nano sensor and light is shone upon the nano sensor, it will reflect different wavelength of light, thus be a different colour.

Common Nanomaterial used as –

1. Carbon nanotubes. (CNTS)
2. Graphene
3. quantum dots
4. metal nanoparticles (gold, silvers)
5. Silicon nanowires.

Production Methods:

There are currently several hypothesized ways to produce nanosensors. Top-down lithography is the manner in which most integrated circuits are now made. It involves starting out with a larger block of some material and carving out the desire form.

These carved out devices, notably put to use in specific micro electromechanical system used as microsensors, generally only reach the microsize, but the most recent of these have begun to incorporate nanosized components. Another way to produce nanosensors is through the bottom – up method, which involves assembling the sensors out of even more minuscule components, most likely individual atoms or molecules.

It involves moving atoms of particular substance one by one into particular positions which though it has been achieved in laboratory test using tools such as atomic force microscopes is still significant difficulty, especially to do in masse, both for logistic reason as well as economic once. This process would be used mainly for building starter molecules for self assembling sensors.

The third way, involves self assembly or “growing” particular non structures to be used as sensors. It have two types of assembly the first involve using a piece of some previously created or naturally formed nano structure and immersing it in free atoms of its own kind. After a given period, the structure having an irregular surface that would make it prone to attracting more molecules as a continuation of its current pattern would capture some of the free atoms and continue to form more of itself to make larger components of Nano sensors.

The second type of self assembly starts with an already complete set of components that would automatically assemble themselves into a finished a product though this has been so far successful only

in assembling computer chips at the micro size researchers hope to eventually be able to do it at nanometer size for the multiple products including nano sensors.

Applications:

1. Medicinal uses of Nano sensors mainly revolve around the potential of Nano sensors to accurately identify particular cells or places in the body in need.
2. By measuring changes in volume concentration, displacement and velocity, gravitational electrical, and magnetic forces, pressure or temperature of cells in a body Nano sensors maybe able to distinguish between and recognize certain cells, most notably those of Cancer at the molecular level in order to deliver medicine or monitor development to specific places in the body. They may be able to detect microscopic variations from outside the body and communicate the changes to other than a products working within the body.
3. One example of Nano sensors involves using fluorescence properties of cadmium selenide quantum dots as sensors to uncover tumors within the body by injecting a body with these Quantum dots a doctor could see where a tumor or cancer cells was by finding the injected Quantum dots and easy process because of their fluorescence.
4. Develop nano sensor Quantum dots would be specifically constructed to find only the particular sale for which the body was at risk as a cadmium selenide dots are highly toxic to the body researchers are working on the developing alternate dot which less toxic and retaining some fluorescence properties.
5. Enzyme - Functionalized CNT biosensors is used for glucose monitoring which detects glucose in diabetic patients.
6. Golden nano particle based biosensors used for Covid- 19 detection which detects viral RNA, proteins quickly.
7. Graphene gas sensor used for detect air pollution which detect NO_2,CO at very low concentrations.
8. For cancer detection Quantum dot biosensor is used which binds to specific cancer markers and fluoresces.
9. Nano sensors with ZnO Nano roads used for explosive detection which detects TNT vapour in defense applications.
10. It is used in agriculture for soil nutrients sensing, in pesticide detection.
11. It is used to in food industry for spoilage detection, food quality monitoring.
12. In medicine it is used for early disease detection drug delivery monitoring.

CONCLUSION:

Nano sensors are highly sensitive miniaturized devices that detect physical, Chemical, or biological changes at the nano scale. They offer fast, accurate detection and have wide applications in medicine, environment and industries with ongoing advancements, they are said to play key role in future sensing technologies.

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