An incisive review of Nanosensors

Inderjeet Kaur*, Navneet Kaur, Maninder Kaur
Department of Biotechnology,
CT institute of Pharmaceutical Sciences,
Shahpur, Jalandhar, Punjab.
*kaur.inderjeet99@gmail.com

ABSTRACT

Nanosensors are increasing expanding consideration because of the need to distinguish and measure chemical and physical properties in hard to achieve biological and industrial systems that are in the nano-scale locale. An option is given in the fast improvement of nanosensors which have favorable position to recognize sustenance segments in a simple and brisk way. Different kinds of nanosensors are being produced to meet the diverse necessities in food inspection (nanosensors for identification of outside and interior conditions in food packaging, carbon nanotubes based electrochemical sensors for recognition of cations, anions and organic compounds in nourishment, different aptamers for identification of pesticides, anti-microbials, overwhelming metals, microbial cells and poisons).

Keywords: Nanosensor, Types, Application, Carbon nanotubes, Current nanosensors.

INTRODUCTION

Nanotechnology guarantees the capacity to manufacture exact machine and parts of molecular size. In its unique sense, 'nanotechnology' refers to the anticipated capacity to build things from the base up, utilizing techniques and tools. In nanotechnology science nosensors are detecting tool with no less than one of their detecting measurements being not more prominent than 100 nm. In the field of nanotechnology, Nano sensors are instrumental for observing physical and chemical phenomenon in locales hard to achieve, biochemical are detect in cellular organelles, estimating nanoscopic particles in the industry as well as in environment. A sensor is an instrument that reacts to a physical stimulation (for example heat, light, sound, pressure and motion).The sensor is in charge of changing over some sort of physical phenomenon into an amount quantifiable by a data acquisition (DAQ) system. Nanosensors are broadly three categories following are

1. optical nanosensors
2. electromagnetic nanosensors
3. mechanical and/or vibrational nanosensors

Need for Nano sensors

- When particles are smaller and specific phenomena are characteristic length often new physics, chemistry which leads to properties of size
- The decrease in the size of the sensing part.
- Sensitivity can increase due to better conduction properties

Table 1: various types of nanosensors (Lim et al., 2006).

Nanosensor type	Sub-category	Measured specimens or physical Properties
Optical	Fiber optic	Benzopyrene tetrol, benzo[*a*]-pyrene, caspase-9 (an apoptosis protein), cytochrome c (a protein involved in producing cellular energy), pH, K^+, Ca^{2+}, NO, NO^{2-}, Cl^-, Na^+
	PEBBLE (direct)	H^+, Ca^{2+}, Mg^{2+}, Zn^{2+}, glucose and dissolved O_2
	PEBBLE (ion-correlation)	K^+, Na^+, Cl^-
Electromagnetic	Current measurement	H_2S, GOx, lactase oxidase, dehydrogenase, peroxidase, hydrogen peroxide, catalase,

How to cite this article: Kaur I, Kaur N, Kaur M; An incisive review of Nanosensors; PharmaTutor; 2018; 6(11); 18-21; http://dx.doi.org/10.29161/PT.v6.i11.2018.18

		organophosphorus pesticides, organophosphorus substrates of organophosphorus hydrolase, DNA, ATP
	Magnetism measurement	Molecular interactions, oligonucleotide sequences, enzymatic activity, viral particles, magnetic field, speed, position sensing
Mechanical	Vibrational	Resonance frequency, spring Constant
	Inertial	Pressure, acceleration, yaw rate

Current nanosensors devices can be divided into (Liu 2006):
Nanostructured materials - e.g. porous silicon,

Classification of porous silicon
- Nanoporous silicon - (features < 5nm)
- Mesoporous silicon - (features 5nm - 100nm)
- Macroporous silicon - (features > 100nm)
- Pores generated by electrical breakdown

Manufacturing Methods of porous silicon
- Electrochemical Etching
- Chemical Etching
- Spark Erosion
- Chemical Vapor Deposition

Properties
- Porosity
- Photoluminescence
- Electroluminescence
- Reflectivity
- Conduction
- Nanoparticles based sensors, Nanoprobes,
- Nanowire nanosensors, Nano systems: cantilevers, Nano-electromechanical systems (NEMS).

Table 2: Carbon Nanotubes based Nanosensors(Craig et al.,2013; Joyner et al.,2015)

System	Target species	Salient feature
Single wall nanotubes (SWNT)	NH_3 and NO_2	Sensitive to 200 ppm of NO2, and 1% of NH_3.
Single wall nanotubes (SWNT)	N_2, He, O_2, and Ar	Gas concentrations as lowas 100 ppm can be detected
Multi-wall carbon nanotubes (MWCNTs)	NH_3	Gas concentrations as lowas 10 ppm can be detected. The sensor showed a reversible response of few minutes.
Poly(*o*-anisidine) (POAS) coated CNT	HCl	Nine times increase in sensitivity compared to uncoated CNT
Single-walled carbon nanotube (SWNT)	β-D-glucose	Senses β-D-glucose in solution phase by two distinct mechanisms of signal transduction: fluorescence and charge transfer.
Poly(vinylferrocene) (PVF) derivatised MWCNTs	Glucose	Glucose concentration in real blood sample can be determined.

Table 3: Nanosensors potential applications in Agri-food sector (Augustin et al, 2009; Berekaa et al.,2015; Rai et al.,2012, Berekaa et al.,2015**)**

Nutrition	• Nanocochleates (50nm coiled nanoparticles) for delivering nutrients(e.g. vitamins, lycopene, and mega fatty acids) more efficiently to cells, without affecting the color or taste of food • Nano capsules incorporated into food to deliver nutrients
Agriculture	• Nanoparticles to deliver growth hormones or DNA to plants in controlled manner • Aptasensors for determination of antibiotics, drugs and their residues (e.g. Cocaine, oxytetracycline, tetracycline, kanamycin). • Nanoparticles used as smart nanosensors for early warning of changing conditions that are able to respond to different conditions • Nanocapsules for delivery of pesticides, herbicides, fertilizers and vaccines • Nanosensors for monitoring soil conditions (e.g. Moisture, soil pH), a wide variety of pesticides, herbicides, fertilizers, insecticides, pathogens and crop growth as well • Nanochips for identity preservation and tracking • Nanosensors for detection of food-borne contaminants or for monitoring environmental conditions at the farm • Nanosensors and nanobased smart delivery systems for efficient use of agricultural natural resources (e.g. water),nutrients and chemicals through precision farming • Nanochips for identity preservation and tracking
Food transport	• Aptasensors for determination of microbial cells(e.g. *Salmonella typhimurium, Escherichia Coli, Listeria monocytogenes)* • Nanosensors for traceability and monitoring product conditions during transport and storage, what is crucial for products which shelf-life • Smart-sensor technology for monitoring the quality of grain, dairy products, fruit and vegetables in a storage environment in order to detect the source and the type of spoilage
Food packaging	• Nanosensors incorporated into packaging materials for detection of chemicals released during food spoilage and serve as electronic tongue (e.g. bitter, sweet, salty, umami, and sour detection), or nose (e.g. wine characterization) • Nanosensors applied as labels or coating to add an intelligent function to food packaging in terms of ensuring the integrity of the package through detection of leaks, indication of time temperature variations and microbial safety • Aptasensors for determination of microbial cells (e.g. *Salmonella typhimurium, Escherichia Coli, Listeria monocytogenes*) • DNA biochips to detect pathogens and to determine the presence of different kind of harmful bacteria in meat or fish, or fungi affecting fruit • Electromechanical nanosensors to detect ethylene
Food processing	• Aptasensors for determination of microbial toxins (e.g. OTA, Fumonisin B1) • Nanocapsule infusion of plant based steroids to replace a meat's cholesterol • Nanotubes and nanoparticles as gelation and viscosifying agents

CONCLUSION

An extensive range of nanosensors has been studied and various their categorized and discussed according to their working. Which was then associated to nanosensors applications. Nanosensors have also potential application in agri-food sector. Which are beneficial in farming growth. There are some carbon nanotubes based nanosensors they have also used in the targeted sites.

REFERENCES

1. Augustin M.A., Sanguansri, P (2009); Nanostructured Materials in the Food Industry, Advances in Food and Nutrition Research; 58; 183-213
2. Berekaa, M. (2015). Nanotechnology in Food Industry;Advances in Food processing, Packaging and Food Safety; Int.J.Curr.Microbiol.App.Sci; 4(5); 345-357
3. Binh V.T, Garcia N.,Levanuyk A.L, (1994); A mechanical nanosensor in the gigahertz range: where mechanics meets electronics; Surface Sci; 301(1-3); L224-L228.
4. Craig A.P., Franca, A.S., Irudayaraj, J (2013); Surface enhanced Raman spectroscopy applied to food safety, Annu Rev Food Sci Technol; 2013; 4; 369-380
5. Joyner J.R., Kumar, D.V. (2015); Nanosensors and their applications in food analysis: a review; The International Journal Of Science & Technoledge; 3(4); 80-90
6. Lim T.C., Ramakrishna S (2006); A Conceptual Review of Nanosensors; Z. Naturforsch; 61a; 402–412.
7. Rai V., Acharya S., Dey N (2012); Implications of Nanobiosensors in Agriculture; Journal of Biomaterials and Nanobiotechnology; 3(2A);315-324
8. Uttamchandany N.,McCulloch D.S (1996); Optical nanosensors — towards the development of intracellular monitoring; Adv. Drug Delivery; 21(3); 239-247.