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Short Communication

Fast Detection Methods for the Monitoring of Environmental Pollutions using Advanced Nano-sensors

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A B S T R A C T

In recent years, there is a need for the development of easy, inexpensive, and fast detection methods for the monitoring of environmental pollutions, such as organic, inorganic, and pathogenic pollutants. Recognizing the pollutants that cause environmental pollution is vital in some emergency situations. For this reason, the need for devices with fast and easy detection capability is increasing. In addition, in practical applications, the freely dispersed molecules in the sample to be analysed are far from plasmonically sensitive surfaces. Therefore, plasmonic nanosensors are important and promising devices in that they combine uniquely different features such as inexpensive, high sensitivity, specificity, label-free, and quantitative detection. In this review, the plasmonic nanosensor principle and plasmonic nanosensors for the analysis of environmental pollutants are comprehensively discussed.

***Key words*:** Nanosensor, Environmental pollutants, Pollution control, Ecosystem

Various methods based on UV-Vis absorption spectroscopy, atomic absorption spectroscopy, ion chromatography, inductively coupled plasma, etc., have been reported for the determination of environmental pollutants [1-9]. Although, these methods are sensitive but require tedious and extensive sample preparation and extraction protocols before analysis. Furthermore, they are expensive and require bulky instruments. The humanity has achieved the modernized living style and economy at the cost of balanced ecosystem. This achievement has left us with severe environmental pollution, that is, heading towards the mass destruction of animals, plants, and human beings [10-12]. Thus, to safeguard the environment and living beings, it is important to maintain the exclusive monitoring system for the determination of environmental pollutants. In comparison, sensing technology is relatively fast, robust, cost effective, and simple. There is plenty of sensing phenomena that can be used effectively for environmental monitoring, such as electrochemical sensing, optical sensing, thermal sensors, biosensors, etc. Among optical sensors; the phenomenon of surface plasmon resonance (SPR) has been established very well [11]. Many selective SPR probes with high-resolution refractive index measurements and excellent specificity have already been reported. Functionalized SPR probes have been developed for environmental monitoring and sensing many compounds of interest at trace levels. For instance, ammonia vapors have been detected via polymer-coated SPR probe [12] and pesticides and other organophosphates have been detected using enzyme modified silver-based SPR sensors [13]. Thus, this technique offers countless strategies for the modification of probes with respect to analytes to be detected in environment.

SPR is a technique that is based on the measurement of refractive index variations occurring between the metallic layer and the dielectric medium at the interface. Broadly speaking, the dielectric medium in the case of SPR is the analyte for which a metallic layer has affinity; that is introduced on its surface via certain surface modification methods. Due to the sensitivity of SPR technique, it is extensively used for the development of biosensors and chemical sensors. To execute the sensing phenomenon practically, the target molecules are brought into contact with a metallic layer via micro-fluidic system using buffer or carrier fluid. The surface modification of the metallic layer plays the role of transducer. The refractive index at the outer interface changes when the target molecules interact with the transducer; and monitored by appropriate optical interrogation [13].

There are wide scopes of pharmaceuticals accessible available for each of known ailment. More often than not patients experiencing interminable confusion where they are required to take meds for a drawn out stretch of time are typically a tricky. Individuals who can't manage the cost of a full-time guardian would here and there might skirt the prescription because of carelessness. This outcomes in the loss of the patient as cash and in addition wellbeing. The present venture will attempt to address this issue by formulating a non-intrusive wearable gadget which can be utilized to screen the level of prescription utilized. Since it's in beginning stages just a single solution will be considered for this-Insulin. Future work will be stretched out to every one of the medications accessible.

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Insulin is a vital biochemical created in human body which holds the glucose level within proper limits. Be that as it may, when a man is not ready to deliver the required measure of insulin independent from anyone else than it must be provided all things considered. In view of the kind of diabetes a man is experiencing diverse measurements of insulin is directed. A non-intrusive glucose meter is non excruciating and simple to convey and utilize, so it is much best than whatever other routine technique for insulin and glucose checking. The fundamental guideline includes the utilization of Near Infra-Red light source as it has much entering power and is non deadly to people. The light beams will enter through the tissue and will be recognized by an identifier on the opposite side. It is realized that the absorbance and the force of Infra Red diminish after association with glucose particle. By measuring the measure of infra red retained one can discover the glucose level and can decide the need of insulin. The gadget was made to be worn in the wrist however a more viable way will be to make it use in the ear projection as it has no bones for prevention. Nearness of bones impacts the infra red on development. Future degree incorporates extending the gadget ability to distinguish the majority of pharmaceuticals accessible available and tweak it as indicated by the patient's endorsed medicine

Surface plasmon resonance

SPR can be examined the molecular interactions simultaneously without using any marking method. The first time, Wood was reported surface plasmon in 1902. Wood was observed anomaly between thin dark bands in the spectrum of light diffraction with a metallic diffraction grating in the polychromatic light path. In 1968 Otto, Kretschmann and Raether, independently of each other, composed surface plasmons by different methods. Since the late 1970s, surface plasmon resonance was used in the characterization of thin films and surfaces of metals. Liedberg et al. developed surface plasmon resonance-based sensors to measure biomolecule-biomolecule interactions in 1983. SPR nanosensor has made wide advances in biotechnology and many applications based on SPR nanosensors have been performed. SPR nanosensor measures a physical or chemical quantity and converts it into a signal that occurs to measuring changes in the refractive index of thin-film refractometers. This change causes a change in the propagation constant of the surface plasmon that alters the coupling condition of the light wave with the surface plasmon.

On the basis of which the characteristic of the light wave interacting with the surface plasmon is measured, SPR nanosensors are classified as sensors with angular wavelength, intensity, or phase modulation. Furthermore, SPR nanosensors can operate on optical, chemical, acoustic, and thermal bases. SPR nanosensors are a label-free technique of optical sensor that has been used for the detection of analytes. SPR systems contain a source of planepolarized light that passes through a glass prism, which contacts a typically a thin film of gold such as a bioreceptor-functionalized transducer surface. Refractive index was a change with analyte binding to the transducer surface, and that was the change angle of light exiting the prism, which named SPR angle. SPR based optical nanosensor is an analytical device with knowledge of chemistry, biology, physics, environment, engineering, science fields that uses biological or biomimetic structures to selectively detect target molecules (Figure 1). Plasmonic nanosensors are rapid and cost-effective tools for the detection of environment pollutants without the need for a specialist users. Plasmonic nanosensors can be classified either by the type of bioreceptor or their signal transducer. Plasmonic nanosensors can measure the changing refractive index based on interaction between the analyte and biorecognition component.

Environmental pollutants

There is one group of chemicals that are classified as "emerging pollutants". These contain hormone-like compounds (endocrine disruptors), pharmaceuticals, pesticides, halogenated flame retardants, etc. Many of these chemicals may appear in wastewater at very low concentrations (sub-nanomolar). At such concentrations, one does not see much efficiency in removing the compounds from wastewater when treated in the biological steps in modern wastewater treatment plants. This is because microbes do not gain much energy from degrading them, and therefore they are released untreated to the recipient. One could imagine that adsorption on the biomass would result in removal from the waste streams. This is obvious for, e.g., heavy metal ions that are captured on the biomass and a similar fate may happen to, e.g., textile dyes. However, when pollutants are enriched in biomass, one then gets a problem of handling the contaminated biomass.

Close infra-red is a strategy that uses the close infra-red vision of electromagnetic range (From around 700nm-950nm). Normally application incorporates restorative and mental diagnostics and research including glucose, beat oximtery, practical neuron imaging, sports solution, light games preparing, recovery, neonatal research, cerebrum PC interface, urology and neurology. There are application in different zones too, for example, barometrical and mix investigate.

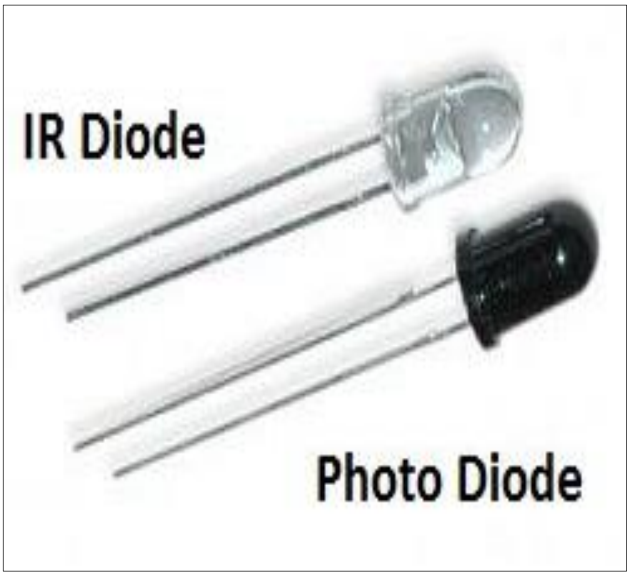

Fig 1 Near infrared sensor

CONCLUSION

It is necessary to develop sensitive, fast, specific, easy-to-use analytical devices against the increasing number of pollutants for early intervention in environmental pollution control. Quantitative analysis to detect different environmental pollutants is usually achieved by conventional analytical methods such as spectroscopic and chromatographic techniques. The methods mentioned are sensitive and accurate, but require expensive and complex instrumentation as well as specialized personnel to prepare multistage samples. Since the recognition of potential pollutants in environmental pollution is of critical importance, there is an increasing need for the development of devices with rapid, superior detection capabilities in the detection of organic, inorganic, and pathogenic pollutants. Today, researchers are making efforts to develop cost-effective and durable automatic water monitoring devices to be used in the sensitive and rapid determination of environmental pollutants. Thanks to sensor technology, which combines many different fields such as chemistry, nanotechnology, physics, biology, and electronics and has unique features such as specificity, speed, sensitivity, ease of use, and real-time remote monitoring capability, it is possible to follow developments in environmental legislation and risk management approaches. A sensor system is defined as an analytical device that integrates a sensing element with a physical transducer such as an optical, thereby converting the interaction between the target and recognition molecules into a measurable electrical signal. Although the use of sensor systems in the field of environmental pollution control, which provides real-time, fast, and high-accuracy results without the need for time-consuming sample enrichment processes, is still in its early stages, it has applications in many different fields. Examples of these areas are diagnostics, food safety, biomedical research, and drug development. Since dispersed molecules that spread freely in the solution are less likely to have sensitive surfaces in practical applications, low-cost sensor systems that do not need labels, show high sensitivity and specificity are promising in this regard. Despite the intense focus on the development of plasmonic nanosensors today, there is still a long way to go in making safer designs. Currently, the most important needs for the development of plasmonic nanosensors can be listed as multi-analyte determination, miniaturization, nanotechnology, production of new recognition components and continuous monitoring of environmental pollution. Since the pollutant concentrations in water resources are dynamic and variable, especially for rivers, it is important to constantly monitor the concentration. Therefore, various biosensor systems are being developed to be used as a continuous monitoring system that allows fast, easy, and on-site analysis for continuous monitoring of pollutant concentrations in certain regions of rivers.

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