Nanoparticles as colorimetric sensors for analysis of pesticides

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Pesticides are widely used to enhance the quantity of agriculture production as they have advantages like crop protection and preservation, but they are toxic and designed to kill insects, weeds, rodents, fungi and other organisms [1]. Their mode of action is by targeting systems or enzymes in the pests which may be identical or very similar to human and therefore, they pose risks to human health and environment, so determination of pesticides in environmental and food samples is very important for both environmental and health point of view. Traditional analytical techniques such as high performance liquid chromatography (HPLC), gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS) suffer from sophisticated and expensive equipment, long analysis time and tedious sample preparations. Importantly, these methods are not suitable for on-site and real-time monitoring of pesticides in agricultural products. So there is a need to develop simple, selective and sensitive methods for analysis of pesticides in environmental and food samples.

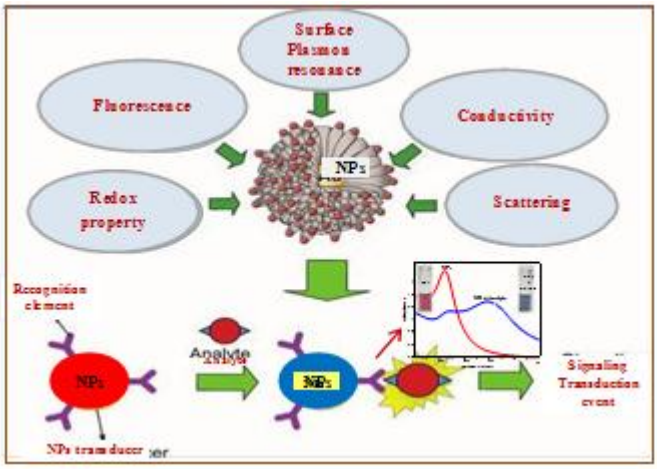

Figure 1: Various properties of NPs and schematic representation of NPs based sensing mechanism.

In recent years, metallic nanoparticles-based colorimetric sensors have gained significant interest to detect/quantify a wide variety of target analyte from various samples matrices, due to their remarkable optical, electrical and physico-chemical properties [2]. Sensing approaches based on colorimetric assays (aggregation) using silver and gold nanoparticles (Ag and Au NPs) have received considerable attention not only because of their excellent analytical performance but also due to easy visualization (even by necked eyes) and avoiding use of expensive or complex instrumentation. More importantly, the introduction of ligands onto Ag/Au NPs surfaces provides stability to these

5th International Conference on Nanotechnology for Better Living (NBL-2019), Jointly organized by National Institute of Technology (NIT) Srinagar and Indian Institute of Technology (IIT) Kharagpur; April 7 – 11, 2019 at SKUAST, Shalimar Srinagar, Jammu and Kashmir, India; Editor: Dr. M. A. Shah and Prof. P. Banerji, ISBN:978-81-939516-0-6; Published by Applied Science Innovations Pvt. Ltd., Pune, Maharashtra, India.

nonentities and desirable surface functionalities for quantifying the trace targets from complex samples. Interaction event between surface functionalized NPs and targeted species induced aggregation of NPs, which leads to decrease interparticle distance which causes a red-shift in the surface plasmon resonance (SPR) with easily observable color change of NPs. This changing in color of NPs solution during aggregation provides a practical platform for absorbance- based sensing approach using simple UV-visible spectrophotometer (Figure 1).

By taking the advantage of the colorimetric sensing properties of Ag and Au NPs, various colorimetric sensors were developed for determination of pesticides in environmental water and food samples

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