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A SPLENDID BLEND OF NANOCHEMISTRY IN FORENSIC SCIENCE: OPPORTUNITIES, CHALLENGES AND WAY AHEAD

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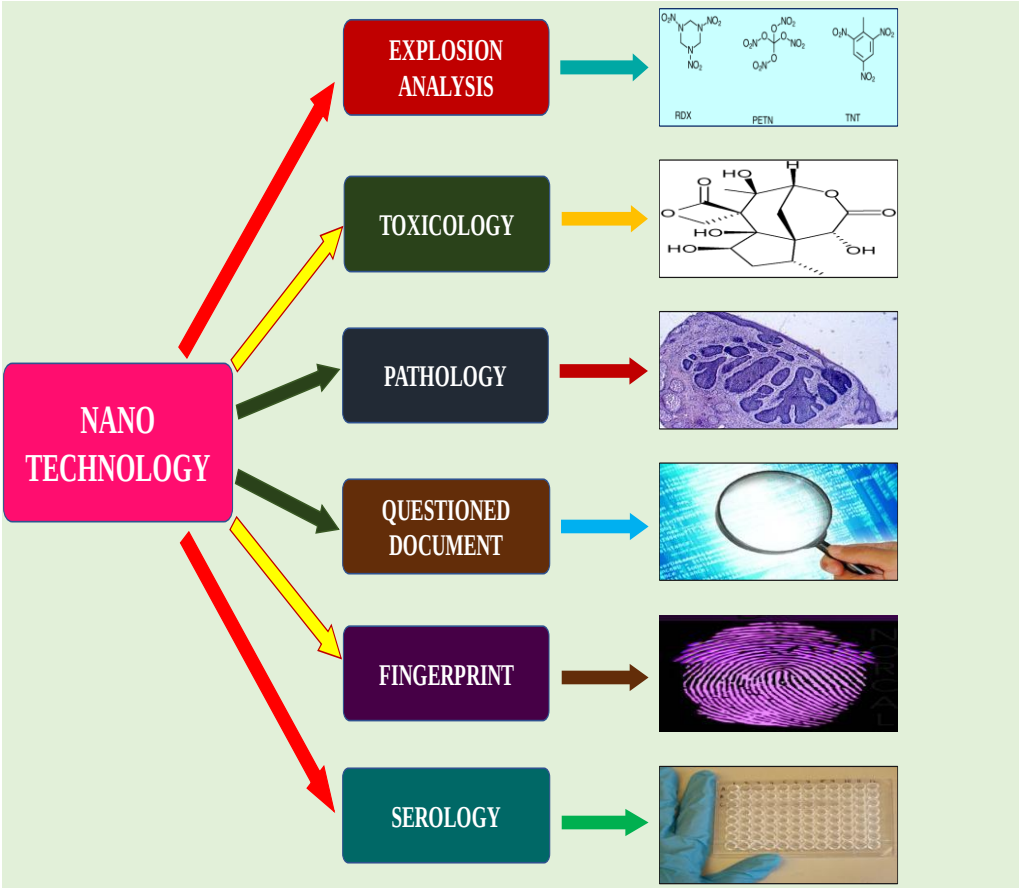
ABSTRACT

Nanotechnology is manipulation of matter on an atomic, molecular and supramolecular scale. The earliest, widespread description of nanotechnology referred to the particular technological goal of precisely manipulating atoms and molecules for fabrication of macroscale products, also now referred to as molecular nanotechnology. A more generalized description of nanotechnology was subsequently established by the National Nanotechnology Initiative, which defines nanotechnology as the manipulation of matter with at least one dimension sized from 1 to 100 nanometers. Nanotechnology has a potential to make significant positive contribution in forensic science in Crime detection. The various uses of nanotechnology in the field of forensics are discussed in this review. In forensic nanotechnology minute chip materials are used instead of bulky instruments, which reduce the methods of analysis to make investigation, accurate, precise, timely and appropriate. This talk aims to highlight some of these applications of Nanotechnology in Forensic Science.

KEYWORDS: Nanotechnology, Forensic nanotechnology, Crime detection, Forensic investigation.

Graphical abstract



INTRODUCTION

Nanotechnology is the managing of matter at a molecular or atomic level. It deals with materials, devices, or other structures possessing at least one dimension sized from 1 to 100 nanometres. The size of nanometer is about 3-5 atoms wide. It includes both man made things and natural things. By using nanotechnology we can produce the devices or materials which extraordinary properties. It is useful in wide areas like biology, engineering, chemistry and physics. Nanotechnology have wide variety of application in different fields like medicine, engineering and electrical field.[1-7] Nanotechnology due to its multipurpose use and advantages in all areas, it referred to as a universal purpose technology since its foremost version will have its impact on relatively on all field, industries and all areas of civilization.[7-9] Nano-forensics, a completely new area of forensic science associated with the development of nanosensors, nanotechnical methods for real-time crime scene investigation and terrorist activity investigations, determining the presence of explosive gases, biological agents and residues. Forensic Science is a broad field of subspecialties which use techniques adapted from the natural sciences to obtain criminal or other legal evidence. Nanotechnology is beginning to have an impact on the handling of evidence at crime scenes, its analysis in the

laboratory and its presentation in the court room. Application of nanotechnology is likely to enhance the capacity to toxic materials, forensic evidence in tissue, materials and soil.

Forensic nanotechnology

Nano-forensics is an entirely novel part of the forensic science accompanied with the enlargement of nanosensors, nanotechnical methods for real-time crime scene investigation and terrorist activity inquiries, detecting the presence of explosive gases, biological mediators and filtrates. Forensic Science is an expansive field of subspecialties which use different techniques amended from the natural sciences to acquire criminal or further legitimate evidence. Nanotechnology is beginning to have an influence on the holding of evidence at crime scenes, its examination in the laboratory and its presentation in the court of law. Application of nanotechnology is possible to augment the capability to toxic materials, forensic evidence in tissue, materials and soil. Nano-analysis is commonly used in the nanotechnology detection of crimes. Some of these analyses techniques are Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Dynamic Light Scattering, and Raman Microscopy.[10] These techniques assist forensic scientists in 2 ways: 1) by making it possible to analyze nano-scaled samples and 2 by making use of the specific effects of nanomaterial to identify and collect evidence, which would not have been possible by previous techniques. DNA extraction from palm-prints, fingerprints, gun residues, explosives and heavy metals are some of the novel approaches that ease the way for forensic scientists to provide conclusive evidence.[11]

APPLICATIONS OF FORENSIC NANOTECHNOLOGY

AFM and the Time of Death

Cai and Chen first reported the application of AFM to resolve one of the most crucial issue in forensic science – the estimation of the time of death[12]. The morphological changes of blood cells can be useful for the quantitative assessment of the time of death. The deformation of cell and membrane surface of unfixed erythrocytes with time lapse is observed. Fissures and cell shrinkage took place in half a day. More protuberances on erythrocytes began to reveal in 2.5 days. The number of protuberance increases with time, so it can be used as an indication for the estimation of the time of death.

Forensic DNA analysis

Forensic DNA analysis is carried in murder cases, rape cases and other crime cases. DNA analysis of blood stains, hairs, fibres semen can be carried out. Micro fluidic devices are the

recent advanced devices used for forensic DNA analysis. The advantages of these devices are shorter examination time, risk of contamination is less, it is directly applicable at the crime scene. Another most important technology is micro fluidic chip technology has already proven to be useful and effective within medical applications, such as for point-of-care use.[13]

Forensic explosive detection

Terrorist activities have been increased globally, which has drawn the attention for the detection of hidden explosives. Nano materials provide a active potential to create sensors for detection of explosives. Systematic and efficient detection of explosives which were hidden in vehicles, luggage and vehicles. Tracing of explosives is a very costly and highly complicated task. Nanostructures are used as sensors for detection of different chemical and biological compounds including explosives. The Ultra small devices have high sensing capability.

CONCLUSION

With the constant development of nanotechnology, nanochemistry, forensic scientists will be encountering various evidences in the nano scale in the future. This review explained the significance of nanotechnology in the field of Forensic science and application of nanotechnology in the various stages of forensic investigation. The different techniques of nanotechnology in different stages of criminal investigation have been discussed.

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