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# THE TOXICOLOGY OF NANOMATERIAL: IMPACTS ON HEALTH AND ENVIRONMENT

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**Abstract**

**The small size of nanomaterial it makes nanotechnology so useful in medicine and industry, it is also one of the main factors that might make them potentially dangerous for human health and environmental. In this review we provide overview and specifically of the toxic response of $TiO_2$ and Ag nanomaterial on human health and environment.**

## INTRODUCTION:

Nanotechnology is growing at an exponential rate and will undoubtedly have both beneficial and toxicological impact on health and environment. Nanotechnology, which involves material and processes on ultra-small scale, is increasingly perceived as one of the key technology of the 21st century. Besides their potential economic value, the benefits offered by nanomaterial are expected to have significant impacts on almost all sectors of the society (medicine, energy, aerospace, plastics, and electronics) [1]. The presence of nanomaterials can make them risky, in particular their mobility and their increased reactivity. Properties of nanoparticles were harmful to living beings or the environment would we be faced with a genuine hazard. In this case it can be called nano toxicity.

While the tremendous positive impacts of nanotechnology are widely publicized, potential threats or risks to human health and environment are just beginning to emerge [2]. With limiting information available for support, critics are presenting number of concerns on the devastating effects of nanotoxicity on human health and the environment [3]. Nanomaterial are currently being widely used in modern technology, there is a serious lack of information concerning the human health and environment implication of manufactured nanomaterials. Since these relatively new material to investigate their toxicological behavior.

Nanoscale is just not small, is a special kind of small [4]. The behavior of nanoparticles is a function of their size, shape, surface reactivity, surface structure and surface charge, chemical composition, presence and absence of functional groups, aggregation and solubility with respect to the surrounding tissue [5]. The large number of variables influencing toxicity makes it difficult to generalize the health risks associated with exposure to nanomaterials. Each nanomaterial must be therefore assessed individually and its particle properties must be taken in to account.

### Specific Size of Nanomaterial:

Size is the key factor in determining the potential toxicity of a particle. Size of nanomaterial is 1 to 100 nm. Which provides the potential for biological injury. The extremely small size of nanomaterial means that they readily gain entry in to the human body. Each type of nanomaterial will exhibit its own unique biological or ecological response that will also differ with shape and dosage. It is important to realize that a wide range of nanoparticles have been shown to create reactive oxygen species both in vivo and in vitro and hence have the potential to induce cell damage. Recent inhalation experiments with rats showed that nanoparticles (25 nm) had reached several organs after 24 h of exposure and (amazingly) the central nervous system [6]. These particles have much large surface-area to volume ratio than do bulk materials, which means that an increased number of atoms are exposed at the material, surface increased surface reactivity of nanoparticles may facilitate interactions with biological molecules such as DNA, Proteins, and membranes ,which also function as nanoscale structures. The consequences of this interaction are oxidant injury,

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conformational change, membrane permeability changes, mutational alteration, signaling effects, ionic exchanges, biocatalytic changes, and enzyme failure [7].

**Effect of nanotechnology on health:**

Certain nanoparticles cause carcinogenicity result development of lung tumor. Many of the genotoxic effects associated with nanomaterials also. Radicals may form on the surface of some nanoparticles that may have toxicological consequences resulting in the formation of reactive oxygen species. Reactive oxygen species have been shown to interact with DNA Resulting in DNA damage that causes fibrosis and lung cancer. The size and shape of nanomaterial interact with DNA, and thus have potential to promote DNA damage or cancer.

Nanomaterials have been studied for their cytotoxic properties and have been shown to cause a time and dose-dependent relationship resulting in apoptosis of various human cell lines. The nanomaterial is thought to cause cellular toxicity by a non-specific association with hydrophobic regions of the cell surface and internalization by endocytosis, and accumulation in the cytoplasm of the cell, resulting cell death.

**Toxicity effect of Titanium Dioxide and Silver**:

Titanium dioxide ($TiO_2$) has been considered as non – toxic particle widely used in the fields of cosmetic, food and drug when the scale comes to nanometer, $TiO_2$ nanoparticles exhibits specific charactistics coupled with unknown risk on health. Work of scientists suggested that Silver is toxic to human and animals depending upon its route of administration, particle size, and dose. Silver nonmaterial is useful to mankind, but at the same time it has severe toxic effects on human health. Enter in the form of ions through various semi- open pores which are present in human body, i. e. skin in the form of Silver protein complexes. Silver ions can also enter to the human body through female genital tract. Lungs, gastrointestinal tract, respiratory tract, mucous membrane of urinogenital tracts.

It is also concluded that silver nanoparticles are necrotic to cell and can rupture cell membrane if taken in higher concentration. Stated that nanoparticles can bind to different tissues and may cause potential toxic effects like cell activation, producing reactive oxygen species, Which are more toxic to tissues, inflammation and finally lead to cell death.

**Effect of nanotechnology on environment:**

There is a small but growing body of scientific studies showing that some nanomaterial are toxic to commonly used environmental indicators such as algae, invertebrate and fish species. There is also evidence that some nanomaterials could impair the function or reproductive cycles of earthworms which play a key role in nutrient cycling that underpins ecosystem function. Most recently, disturbing new evidence has shown that nanomaterial can be transferred across generation in both animals. Furthermore, even if used in smaller quantities than conventional chemicals, nanomaterial may have a greater toxicological burden. In 2006 the Woodrow Wilson international center for Scholars, project on Emerging nanotechnologies (PEN) estimated that 58,000 metric tons of nanomaterial will be produced World-Wide from 2011 to 2020. PEN stated its concerns that given the potency of nanomaterial. This could have an ecological impact equivalent to 5million metric tons – or possibly even 50 billion metric tons- of conventional materials.

**CONCLUSION:**

The potential harmful side effect of nanotechnology suggested that, under certain circumstances, nanomaterials may pose risk to health because the insoluble nanoparticulate carriers may accumulate in human tissues or organs [8].

These findings highlight the important role that nanotoxicological studies may play in the responsible development of nanotechnology and considerable benefits they may offer to the society. Health and environmental issues combine in the workplace of companies engaged in producing or using nanomaterials and in the laboratories engaged in nanoscience and nanotechnology research. It is safe to say that current workplace exposure standards for dusts cannot be applied directly to nanoparticle dusts. The rate of innovation in this sector far outstrips our capacity to respond to the risks, there is an urgent need for more research and testing of nanomaterials. Experts on the Commission estimated Britain and the rest of the world has about a decade to carry out research on the safety of nanotechnology before the use of nanomaterials, ranging from the diameter of a DNA strand to that of a virus, become too widely-used for any damage to be halted. Nanometerial substance and assume that nanoparticles are a potential hazard until shown otherwise, estimate their unintentional release. Professor Susan Owens, of the University of

Cambridge, said: “If we don’t do anything and we leave it, then things manifest themselves in 10 to 15 years’ time. By then the technology is so embedded in society it’s very difficult to deal with it.”

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