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# Health Aspect of Nanostructured Materials

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During the last decade, nanostructured materials are being arbitrarily utilized for biomedical applications like imaging, diagnosis and drug delivery due to their unique properties [1-3]. Beside this, nanomaterials products are commercial available for hair care, sunscreens, pigments, coatings, ceramic products, and paints. The worldwide commercial value of nanoproducts is estimated approximately as $1 trillion. As the public concern of nanoproducts, the potential harm effects of nanomaterial have an important issue because of their cyto and geno toxicity effect that is not yet much studied. There is also an ongoing debate about the regulation of nanomaterials.

Due to their small size, surface charge, high surface energy and provide more accessible binding reactive sites on nanomaterials surface resulting in easily internalized into the cells. Internalization of nanomaterials could be occurred *via* different endocytic pathways comprising phagocytosis ("cell-eating") and pinocytosis ("cell-drinking"), clathrin-mediated endocytosis, caveolae-mediated endocytosis, and other alternative routes. The internalization of nanomaterails also depends on their size, shape, chemical composition, and surface modification. Simultaneously, their interaction depends on their dynamic physicochemical properties, kinetics and thermodynamic exchanges between nanomaterial and cell surfaces and organelles (e.g. proteins, DNA, membranes, phospholipids, endocytic vesicles, organelles and biological fluids) [4]. Whenever, the nanomaterial reacts with cells**,** induces their prooxidant effects in term of oxidative stress, inflammation, genetic damage, and the inhibition of cell division and finally cell death. On the based on various reported, it is fund that nanomat**e**rials also generate reactive oxygen species (ROS) (which can be either protective or harmful during biological interactions). Some nanoparticles (NPs) have been shown to activate inflammatory cells such as macrophages and neutrophils which can result in the increased production of ROS. The mechanism for ROS generation is different for each NP and to date the exact underlying cellular mechanism for ROS generation is incompletely understood and remains to be elucidated.

Among the various nanomaterials including metal oxide NPs are widely utilized in biomedical applications and give more attention towards toxicity study. Seabra et al., [5] summarized the results reported on *in vitro* and *in vivo* cytotoxicity and genotoxicity studies of graphene-related materials Khan et al., [6] evaluated the toxic effect of zinc and titanium oxide NPs at different concentrations (50, 100, 250 and 500 ppm) used human erythrocytes and lymphocytes as *in vitro* model species. Concentration dependent hemolytic activity to RBC's was obtained for both NPs. ZnO and $TiO_2$ NPs resulted in 65.2% and 52.5% hemolysis at 250 ppm, respectively indicates that both are cytotoxic to human RBCs and both NPs were found to generate ROS concomitant with depletion of glutathione and GST levels and increased SOD, CAT and lipid peroxidation in dose dependent manner. Recently, Golbamaki et al., reported in a report after the critical analyzing the various research articles based on metal oxide or silica nanoparticles, found that the nanomaterials of same core chemical composition did not show different genotoxicity study calls (i.e. positive or negative) in the same test [7]. Nanomaterial's in different size, surface area variation, various purities of nanomaterials; variation in surface areas for nanomaterials with the same average size; differences in functionalization/ coatings; differences in crystal structures of the same types of nanomaterials; differences in size of aggregates in solution/ media; differences in assays; different concentrations of nanomaterials in assay tests. However, extensively well designed, genotoxicity studies are required, with a particular need for more *in vivo* experiments. Indeed, due to the observed inconsistencies in the recent literature and the lack of adherence to appropriate, standardized test methods, reliable genotoxicity assessment of nanomaterial is still challenging.

## References

1. Solanki PR, Kaushik A, Agrawal VV, Malhotra BD (2011) Nanostructured metal oxide-based biosensors. NPG Asia Materials 3: 17-24.
2. Patel MK, Solanki PR, Seth S, Gupta S, Khare S, et al. (2009) CtrA gene based electrochemical DNA sensor for detection of meningitis. Electrochemistry Communications 11: 969-973.
3. Kaushik A, Solanki PR, Kaneto K, Kim CG, Ahmad S, Malhotra BD (2010) Nanostructured iron oxide platform for impedimetric cholesterol detection. Electroanalysis 222: 1045-1055.
4. Nel AE, Madler L, Velegol D, Xia T, Hoek EMV, et al. (2009) Understanding biophysicochemical interactions at the nano-bio interface. Nature Materials 8: 543-557.
5. Seabra AB, Paula AJ, Lima R, Alves OL, Duran N, et al. (2014) Nanotoxicity of Graphene and Graphene Oxide Chem Res Toxicol 27: 159-168.
6. Khan M, Alim Husain Naqvi, Masood Ahmad (2015) Comparative study of the cytotoxic and genotoxic potentials of zinc oxide and titanium dioxide nanoparticles. Toxicology Reports 2: 765-774.
7. Golbamaki N, Rasulev B, Cassano A, Robinson RLM, Benfenati E, et al. (2015) Genotoxicity of metal oxide nanomaterials: review of recent data and discussion of possible mechanisms. Nanoscale 7: 2154-2198.

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