Health Impact of Engineered Metal and Metal Oxide Nanoparticles: Response, Bioimaging and Distribution at Cellular and Body Level

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Metal oxide and metal NPs are widely used in various industrial processes and common products. Some examples of these are TiO_2 and ZnO as catalysts and UV protectors, CuO in anti-fouling paints, Al_2O_3 as a surface protector, CeO_2 in polishing, and various rare earth oxides in electronics, among many other aplications.

Metal and metal oxide NPs may be toxic for two reasons: i) They may possess increased catalytic activity due to nanoscale structure or chemical modification of their surface. These catalytic properties may interfere with numerous intracellular biochemical processes. ii)The decomposition of NPs and subsequent ion leakage may result in a continuous formation of free radicals and metal ions, which may heavily interfere with the intracellular free metal ion homeostasis, which requires that metal ions are kept at extremely low levels in the cytoplasm.

Previous research and hypothesis suggest that the particle size, shape, chemical composition and the chemistry of the capping agent determine the catalytic properties and surface activity of NPs as well as the materials where the NPs are incorporated. These properties are important for the applications of the NPs and must be studied in the context of their effects on human health.

Our approach to the problem is multidisciplinary and involves:

1) Characterization of commercially available NPs, and the fabrication and characterization of NPs with specific properties and with either fluorescence or radioactive labelling.

2) Technical development and analysis of the uptake, distribution and release of NPs *in vivo* and in cells**.**

3) Understanding the interaction of NPs with cellular and extra-cellular components

4) Determination of physiological effects of NPs *in vitro*.

5) Risk of exposure and toxicological effects of metal and metal oxide NPs**.**