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Session 1: Materials

Development of dispersion procedures for surface-functionalized CuO nanoparticles to use in large-scale toxicity studies

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CuO engineered nanomaterial (ENM) is widely used (e.g. biocide in textiles) and is highly toxic compared to other metal oxide ENM and bulk CuO[1]. Industrial ENM production often yields agglomerated/sintered nanoparticles in the nanopowder product[2-3]. Since ENM toxicity depends greatly on particle size and surface composition, it is relevant for toxicity studies to develop dispersion procedures that result in stable and monodisperse ENM aqueous suspensions. The aim of this study was to compare dispersion techniques for CuO ENM for later use in a wide range of toxicity studies[4].

CuO ENM was synthesized by pyrolysis and subjected to dispersion by ball-milling with ZrO_2 beads in aqueous or dilute acetic acid suspensions, or to dispersion in water by ultrasound probe sonication. Milling in diluted acetic acid resulted in monodispersed ENM with smaller mean hydrodynamic diameters compared with the other techniques. Acetic acid treatment led to CuO-clusters/ions release into the solution, as verified by inductively coupled plasma mass spectrometry (ICP-MS) analysis of ENM filtrates. Imaging by transmission electron microscopy (TEM) showed that the probe sonicated ENM suspensions were composed of aggregates of varying sizes, but with constituent nanostructures below 100 nm.

Ball-milling in acetic acid can introduce artifacts that would affect toxicity studies, e.g. release of Cu-ions or defects on the CuO crystal structure. Therefore, the probe sonication procedure was further applied to disperse pristine and functionalized ($CH_3NH_2^+$ or COO^-) CuO ENM variants.

Calibration of the ultrasound probe by calorimetry[3] enables that similar ENM suspensions can be obtained across laboratories using different equipments.

References:

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