Evaluation of health risks of technical nanoparticles – the contribution of characterization

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Motivation

Toxicological investigations on nanoparticles (NP) require a comprehensive chemical-physical characterization to gain relevant information about the powder to be analyzed. Furthermore, it is necessary to know the particles' behavior in water and physiological media exactly.

Results

Powder characterization

- Surface characteristics (Coating)
- State of aggregation
- Primary particle size
- Crystal structure
- Specific surface area and porosity
- Chemical composition and impurities

How are nanoparticles?

Preparation and assessment of suspensions

If taken up into organism, nanoparticles come into contact with body's own liquids (lung surfactant, blood) and so suspended NP have to be observed. In vivo and in vitro experiments reconstruct these conditions. Before studying the NP behavior in physiological media, the preparation and assessment of an electrostatically stable non-physiological NP suspension – in the simplest case by using water – is necessary.

The NP suspension can be stabilized electrostatically at high absolute values of the zeta potential. Hence, a pH adjustment or an addition of a non-toxic dispersant is often needed.

Under these circumstances agglomerates can be destroyed via ultrasonication without inducing a reagglomeration. However, the primary particles are present in the form of aggregates. A breakage into isolated particles is usually not possible.

Behavior in physiological media

The stable well-defined initial NP suspension is added to the appropriate physiological media. The chemical-physical and also toxicological behavior of the particles in these media can be analyzed now.

Conclusions

Chemical-physical characterization
- Powder assessment as basis for all further examinations
- Preparation of stable, deagglomerated nanoparticle suspensions based on the analysis of zeta potential and particle size
- Description of the behavior in physiological media, especially of agglomeration and influence of proteins

The method was tested and verified for example on Al2O3, ADOOH, TiO2, TiN and WC particles. Due to the standardized method, the approach is adaptable to many particle systems. Handling with NP in toxicological experiments will be simplified and more reproducible.

As a consequence, a better correlation between chemical-physical data and toxicological results is possible.

Aims

- Characterization of the powders
- Development of nanoparticle suspensions for the use in toxicological experiments
- Studying the behavior of particles in physiological liquids