Development and comparison of in vitro toxicity methods for nanoparticles

Focus on lung cell exposure

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Academic dissertation for the Degree of Doctor of Philosophy in Applied Environmental Science at Stockholm University to be publicly defended on Friday 25 November 2016 at 10.00 in William-Olssonsalen, Geovetenskapens hus, Svante Arrhenius väg 14.

Abstract

Concerns for the toxic effects of airborne nanoparticles have been raised along with the increasing production of nanostructured materials. However, the health risks of nanoparticle exposure are currently not fully understood. The most commonly used techniques to study nanoparticle toxicity, both *in vivo* and *in vitro,* have several limitations. These include for example challenges regarding dosimetry or the lack of similarity of overall exposure conditions and the physico-chemical particle characteristics. Therefore, there is a need for more advanced methods to study the pulmonary toxicity of airborne nanoparticles.

This thesis presents the use of air-liquid interface (ALI) systems as a possible approach to this challenge. While utilizing the direct deposition of airborne nanoparticles on lung cell cultures, the ALI approach can more realistically mimic the characteristics of the human respiratory tract and the interactions of airborne particles with lung cells. This allows for a better understanding of the health risks posed by inhalation exposure to nanoparticles.

Two different ALI systems were investigated and their use was compared to submerged exposure methods. One of the ALI exposure systems utilizes electrostatic force in order to make the deposition of charged airborne nanoparticles more efficient, while the other system operates by the diffusion of airborne nanoparticles. ALI and submerged exposure methods were used for investigating the cytotoxicity and genotoxicity of Ni-containing nanoparticles as well as the cytotoxicity and inflammatory potential of CeO_2-nanoparticles. While Ag-nanoparticles were used as a test material during the development of the electrostatic ALI system, their cytotoxicity was investigated in ALI exposure. In conclusion, the ALI exposure methods provide more realistic conditions and make the particle dosimetry more controllable.

Stockholm 2016
http://urn.kb.se/resolve?urn=urn:nbn:se:su:diva-134125

ISBN 978-91-7649-490-5

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