Exposure, and Health Risk Assessment of Nanoparticles

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Outline

Exposure, and Health risk Assessment of Nanoparticles

Background of our project
Objectives
Topics of current results

Background of project

Nanotechnology has huge potential to bring beneficial impact on society.
Nanoparticles play a key role in the nanotechnology.

Due to the extremely small size, nanoparticles have new chemical and physical properties and different correspondence to external stimuli,

Nanoparticles will be applied variety of industrial fields.
Amount of production of nanoparticles is increasing.

Large number of nanoparticles are released from diesel engines.

Possibility of exposure to nanoparticles might increase.

Health impacts should be assessed.

Little has been done concerning,

1) exposure assessment of manufactured and ambient nanoparticles
2) health and environmental risk assessment.

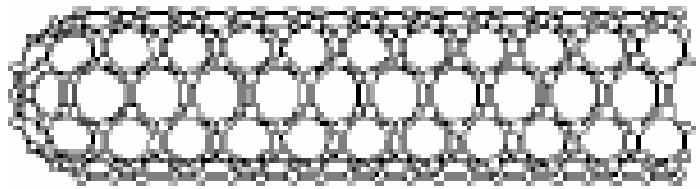
Possibility of exposure to manufactured nanoparticles

1. Manufacturing process

ex. unexpected failures (leakage).

2. Handling and treatment process

ex. collecting, bagging, packing
cleaning of apparatus



3. Application process

ex. wear coatings, cutting,

4. Final product consuming process

ex. cosmetics, sun protection, lipsticks, medicine, food, paint,

5. Abolishing process

ex. break down building, abolishing final product

Little has been done concerning the exposure assessment of nanoparticles in workplace in japan.

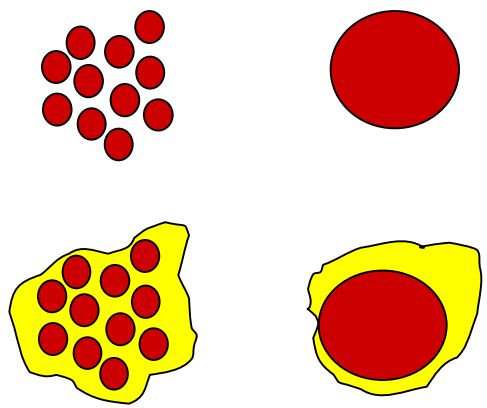
Chemical & Physical Properties and Toxicity of Nanoparticles

1. Nanoparticles are extremely small.

   Chemical & Physical properties may change corresponding with their size. New properties can be linked to their toxicity.

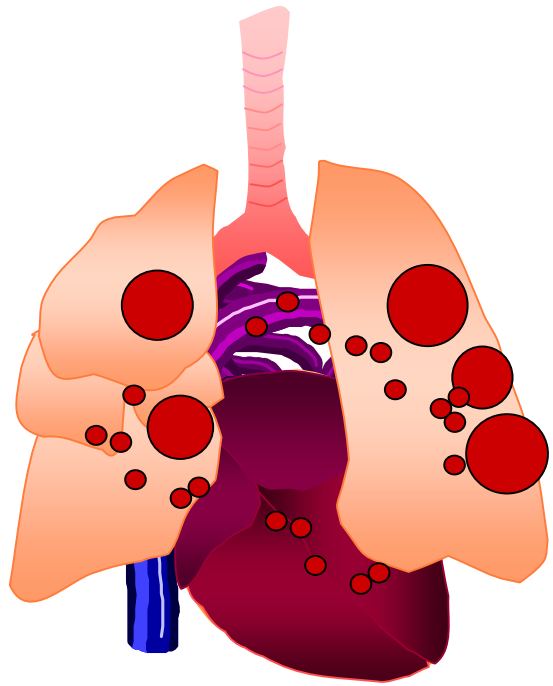
2. Nanoparticles have larger surface area.

   Chemical properties of surface and adsorbed substances of particles can be linked to their toxicity.



Behavior and Translocation of Nanoparticles

1. 100-5nm and 5nm> nanoparticles deposit mainly in the alveolar and nasal regions, respectively.
2. Clearance of nanoparticles from the lung is more slowly than fine particles.
3. More nanoparticles translocate to interstitial sites and to regional lymph nodes compared to the larger particles.
4. Inhaled nanoparticles may migrate from the lungs to the circulation.



Objectives of NIES Project

1) Exposure assessment of nanoparticles.
2) Health risk assessment of nanoparticles.

1) Exposure assessment
Measurement of number and weight of nanoparticles in the workplaces under consideration life cycle analysis of nanoparticles.

2) Health risk assessment:
Analysis of toxicokinetic behavior and toxicological effects of manufactured and ambient nanoparticles using comprehensive, sensitive and specific biomarkers.

1) Exposure assessment of nanoparticles

1. Assemble available information on the possible exposure to manufactured nanoparticles in the workplace and ambient nanoparticles.

2. Studies on the methods of measurement of airborne nanoparticles. ex. number concentration, surface area, mass concentration, size distribution of number, surface area and mass, morphology, chemical properties

3. Measurement of number and weight of nanoparticles in the workplaces under consideration life cycle analysis of nanoparticles.

4. Measurement of number and mass concentration and size-distribution of ambient nanoparticles at roadside.

5. Measurement of number and mass concentration and size-distribution of ambient nanoparticles from diesel engine in various driving conditions.

6. Evaluation of exposure to manufactured nanoparticles in the workplace and ambient nanoparticles.

2) Health risk assessment of nanoparticles

1. Assemble available information on the health risk using Web of Science
2. Analysis of toxicokinetic behavior of nanoparticles using simulated alveoli composed alveolar epithelial cells and endothelial cells in vitro and intra-tracheal instillation and exposure in vivo studies.
3. Effects of manufactured and ambient nanoparticles on epithelial cells to detect comprehensively and sensitively using DNA chip.
4. Effects of manufactured and ambient nanoparticles on inflammatory response, diseases related with immune function, coagulation & fibrinolysis and cardiovascular function.
5. Estimation of threshold using dose or concentration response curve.
6. Using the results of exposure assessment and toxicological studies, we assess health risk.

Topics of current results

1. Smaller size gold-nanoparticles translocate from alveoli to the circulation.

2. Toxicological effects nanoparticles of carbon black.

2.1. in vitro study: Smaller size carbon black-nanoparticles consume more reducing reagent (dithiothreitol , DTT) and induce more hemeoxygenase-1 (HO-1).

2.2. in vivo study:

2.2.1. Smaller size carbon black-nanoparticles induce more inflammatory response and more production of proinflammatory chemokine such as MIP-1α, MCP-1 in lung.

2.2.2. Smaller size carbon black-nanoparticles aggravate allergic asthma like symptoms.

2.2.3. Smaller size carbon black-nanoparticles aggravate symptoms of pneumonia induced by LPS.

2.3. Construction of facilities for studies on health effects of ambient nanoparticles

2.3.1. Construction of exposure system of diesel-nanoparticles, one of the main contributor of ambient nanoparticles, has finished.

2.3.2. We start search optimal driving mode to generate nanoparticles

Facilities for studies on health effect of ambient nanoparticles

Exterior of Nanoparticle health effect laboratory

Diesel engine and dynamo for generating nanoparticles

Dilution tunnel

Exposure chambers

Summary

1. Objectives of NIES Project are
   1) Exposure assessment of nanoparticles.
   2) Health (and environmental risk) assessment of nanoparticles.

2. Topics of current results are
   2.1. Smaller size gold-nanoparticles translocate from alveoli to the circulation.
   2.2. Smaller size carbon black-nanoparticles have more oxidative ability and induce oxidative stress, more inflammatory response and more production of proinflammatory chemokine.
   2.3. Smaller size carbon black-nanoparticles aggravate allergic asthma like symptoms and pneumonia.
   2.4. Construction of exposure system of diesel-nanoparticles has finished. We start search optimal driving mode to generate nanoparticles

Thank you very much for your kind attention.