European Strategy for Nanosafety

nano SAFE

Safe production and use of nanomaterials

# First results for safe procedures for handling nanoparticles

*Dissemination report*
*October 2008*
*DR-331 200810-6*

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*Dissemination reports from Nanosafe2 project are designed to highlight and present in a simplified way the main results obtained in the studies carried out during this project. These reports mainly deal with one question which is of general concern for whom is interested by the safe production and use of nanomaterials. The full results are summarized in the corresponding Technical reports.*
***All the Dissemination reports and Technical reports are publicly available from Nanosafe2 project website**: **http://www.nanosafe.org***

## Refer to:

*D331: Comparison of best practices performed by industries, issues by SWISSI*

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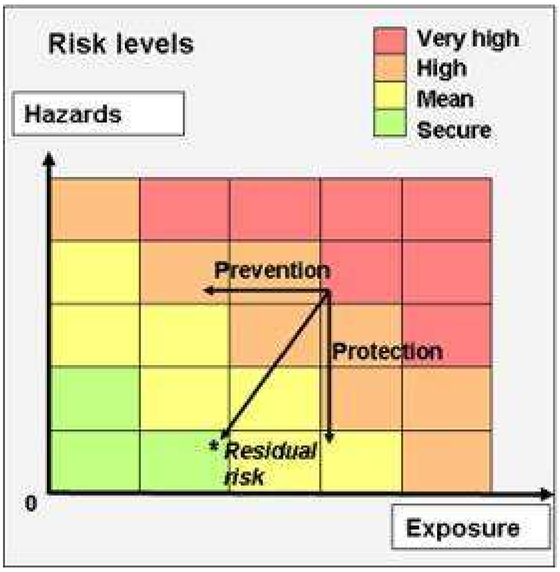
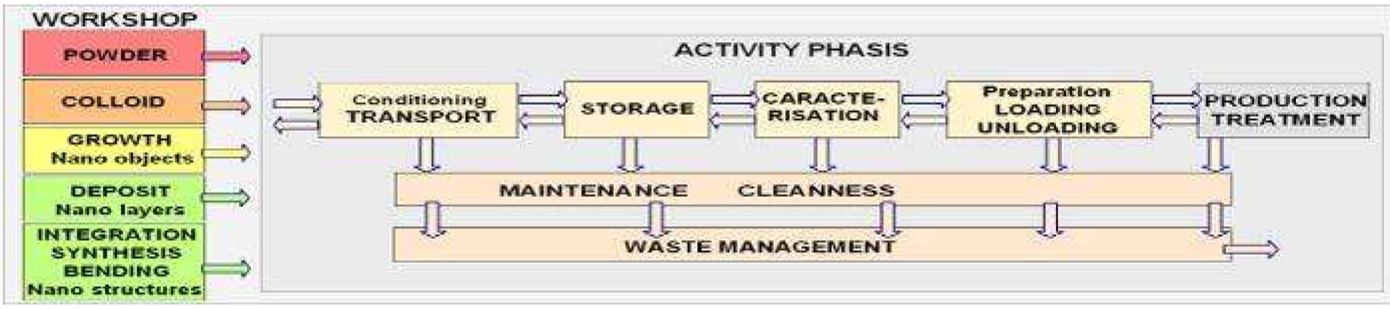
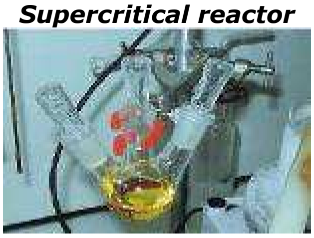
# Which practices are currently used to minimize the potential risk of nanoparticles?

| | |
|---|---|
| *Generally it is of common knowledge that risk assessment in using hazardous or potentially hazardous chemical substances, either the exposition itself or the risk of those materials has to be minimised. The potential danger for someone can be derived from the basic fact, that direct contact with a potentially harmful substance has to be avoided.*<br><br>*Currently, it is still quite unclear, which nanoparticulated material in which state and from reveals which type of danger. It is also unclear, if current measurement and classification of conventional materials, such as critical mass concentration at working places can be applied for the industrial usage of nanoparticles at all.* | <br>***Common options to reduce a risk level*** |

*The main hazards of the production of nanoparticles are the physiological hazards, i.e. by **inhalation**, and the **fire and explosion** hazards. Safe procedure for handling nanoparticles have to defined for each phases of activity and for different types of nanoparticles used in different process.*




***Types of particles and phases of activity***

| ***Plasma torch***  | ***CVD***  | ***Supercritical reactor***  | ***Nanoformulation***  |
|---|---|---|---|
| *Metallic and ceramic dry powders (basic oxides, nitrides & carbides)* | *Carbon nanotubes* | *Various oxides: SiO2, Iron and Titanium oxides, simple and complex oxides* | *Nanodispersions in general, e.g. containing Indiumtinoxide (ITO), silver, ZnO and others* |

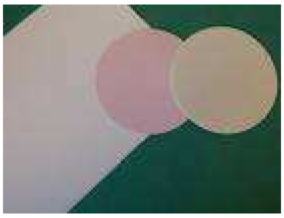
# *What strategies are currently in place during PRODUCTION?*

***Exposure***

*To limit the employee exposition, the first approach to ensure the strict avoidance of any free air flowing nanoparticles. If these statuses are not applicable, the process containment should be maintained as much as possible. When the process containment is not possible, an efficient local exhaust system equipped with a particle filter, e.g. HEPA H14 should be used as well as extended personal protection equipments (gloves, masks, suits, safety shoes).*

*The disposable nitrile gloves appeared to be especially adapted for the work with nanoparticles. Concerning the respiratory protection, the powered respirators incorporating helmets provide the best and more comfortable solution. On the other hand using filtering half masks of the class FFP3 where necessary is also a widespread practice.*


***Masks and respiratory protection filters***



***HEPA Ventilation filters***

***Different gloves***

***Different gowns***


***Fire and explosion***

*The fire and explosion hazards can be controlled by providing an inert atmosphere with the introduction of inert gas during the production. If the use of inert gas is not possible during the production, the oxygen level has to be monitored and linked to an alarm system. EX-zones are generally to be identified and put in place.*

***Avoid free flowing nanoparticles in air***
***Eliminate ignition sources***

## *What strategies are currently in place during (UN)LOADING?*

***Exposure***

*The unloading of the reactor and the preparation for the storage are especially critical steps. As much as possible, the process containment has to be maintained during this transfer. This can be done either by using a glove box system or by emptying the reactor using an industrial vacuum cleaner with HEPA filter through a liquid trap.*

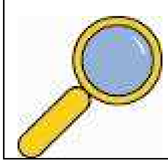
***Glove box & HEPA filteron Nanomil workshop*** *CEA DRT*

*If the particles containment is not possible, the transfer has to be done either within a laminar air flow booth or within an extraction hood. In addition the transfer to container can be done in a room isolated from the rest of the laboratory equipped with an HEPA (H14) filter. Powders should be scooped rather than poured to minimize the dust clouds. Extended personal protection equipments are required for these steps.*

***Common anti static bag***

***Fire and explosion***

*The use of anti-static bags filled with argon, nitrogen or evacuated and thermally sealed for the storage has been reported in two cases. Thus, ceramic powders are stored in anti-static bags within plastic containers and metal powder stored in metal containers. EX-zones should be defined.*



***Extended personal protection equipments are required during (un)loading processes.***
***EX-Zone should be defined.***

## *What strategies are currently in place during CLEANING?*

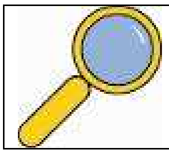
***Specific vacuum cleaning*** *CEA DRT*

***Exposure***

*The cleaning is also a critical step in the nanoparticles' production. The use of an* ***easily cleanable surface*** *is important, e.g. inox hood special entirely paved cleaning room. The* ***vacuum cleaning*** *appeared to be an efficient method however, it needs to be appropriately selected to avoid dust explosion. One method is using the vacuum cleaning to empty its reactor. The nanoparticles are trapped in a water filled drum. Another is using a* ***variable speed fan*** *to draw the powders into a powder collection system. The components are afterwards cleaned under a laminar air flow booth with a HEPA filtration and an explosion vent panel. The vacuum cleaning is used in a final step combined with brushing to remove the surplus material. The soiled equipment is cleaned in a special room with HEPA filter (H14) and with a washer to clean the suits (room mentioned above for the transfer to container).*

***Fire and explosion***

*To avoid the fire and explosion risk, the nanoparticles should, where applicable, be* ***passivated*** *with the introduction of a controlled amount of oxygen. The temperatures and pressures within the system should then be measured over a certain period. The components should be grounded when possible and non-sparking tools should be used when necessary. EX-zones should be defined.*



***Vacuum cleaning or variable speed fan with appropriate nanoparticle collection appear to be efficient cleaning method.***

## *What strategies are currently in place during OTHERS STEPS?*

***Waste disposal***

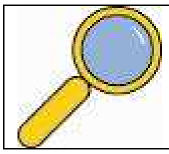
*Typically, waste is collected in specific drums and treated as hazardous industrial waste. The powders are put into anti-static bags within containers to re-use containers and minimize the waste. Metal powders are stored in metal containers and oxide materials are stored in plastic containers. The disposable equipment is normally incinerated or disposed via landfill. Waste powders are recycled where possible.*

***Labelling***

*The powders have to be properly labelled for the expedition in accordance with the government regulations. In some cases a pictogram is glued on the container and this container is placed in a plastic bag, thermally sealed. Additional information relating to the possible additional hazards of nanopowders (MSDS, recommendations) has to be added.*

***Packaging***

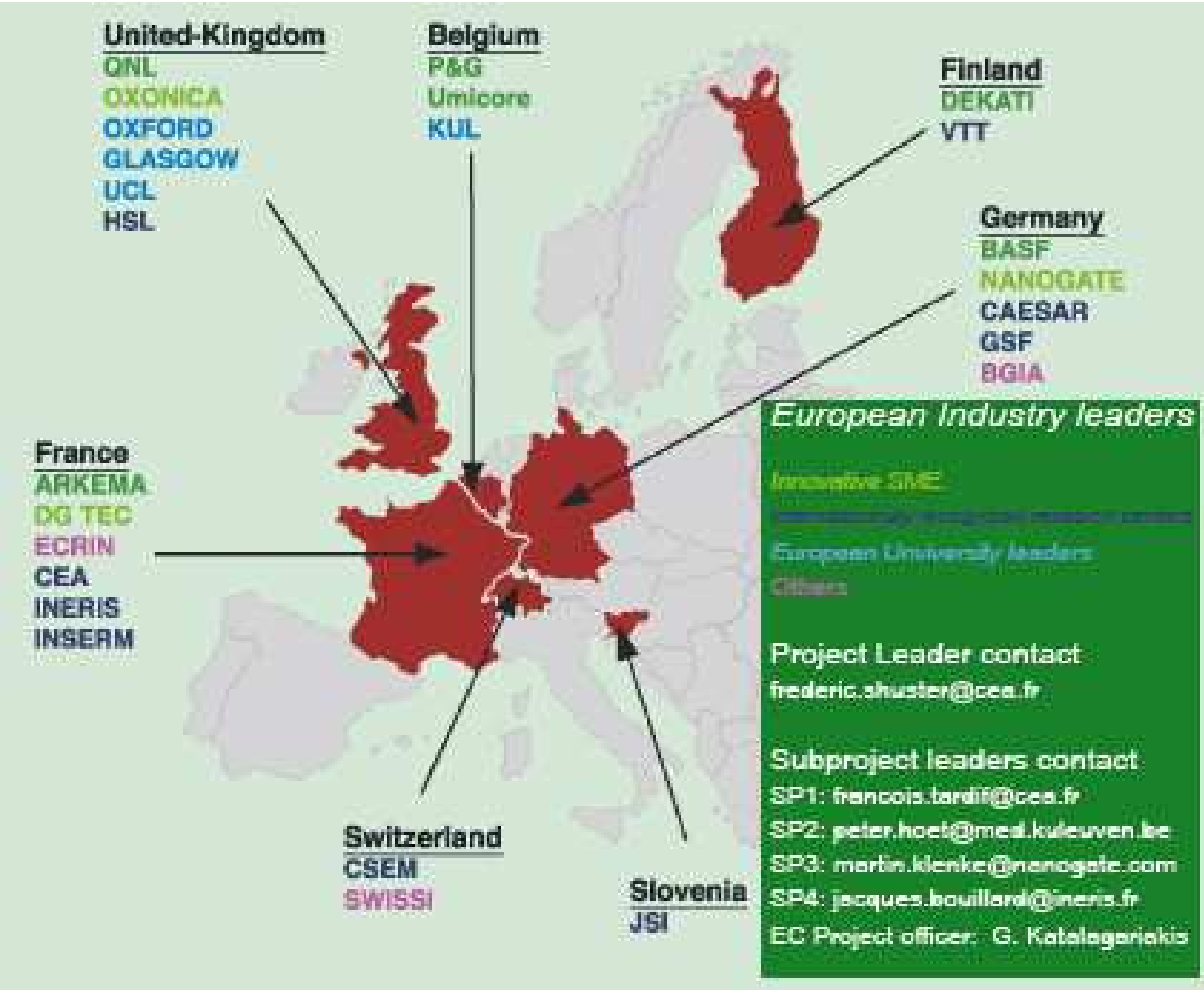

*The UN Regulations on the Transportation of Dangerous Goods, IATA, IMO, ADR regulations have to be followed when applicable.*



***In terms of waste disposal labelling and packaging are carried out according to national and international regulations.***

*Nanosafe2 brings together twenty five partners from seven countries of the European Union, mainly small, medium and large enterprises and public research laboratories. The project is supported through the Sixth Framework Programme for Research and technological Development of the European Commission and addresses the thematic priority3.43.2-1: Hazard reduction in production plant and storage sites. The project started in April 2005 and will end in March 2009.*
*Nanosafe2 main objective is to develop risk assessment and management for secure industrial production of nanoparticles. It focuses on four areas: detection and characterisation techniques, Health hazard assessment, development of secure industrial production systems and safe applications, societal and environmental aspects.*

## Partners




## [http://nanosafe.org](http://nanosafe.org)

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## *Final suggestions*

- ***Use of nanoparticles in dispersion or in an agglomerated state.***
- ***If this cannot be done, secure process containment is a must.***
- ***Inert processes, if applicable.***
- ***Efficient exhaust systems with particles filtration (e.g. HEPA filter H14).Personal protection equipment (Nitrile glove (2 pairs recommended), Mask (FFP3 or powered respirators incorporating helmets), Suits and safety shoes).***

***http:/www.nanosafe.org***