

Compilation of nanomaterial exposure mitigation guidelines relating to laboratories

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Background

Nanotechnology is regarded as future technology with increasing social and economical importance. Despite of the new chances this expanding technology brings, the human health risks of nanomaterials have not been assessed finally and/or fully in all cases. Even though adequate workplace controls for the use of nanomaterials in large-scale production plants are applied, common standards do not exist yet. In addition to the low number of high volume nanomaterials produced in large-scale, a high quantity of different nanomaterials are applied in a laboratory scale such as during subsequent processing of a nanoscaled product in low scale. Nanomaterials are thus produced and handled by institutions and companies entering the nano-sector in many countries.

For this reason, a compilation of nanomaterial guidelines relating to laboratories will supposedly meet a wide interest since it will provide support for the exposure mitigation and therefore generally for the occupational safety and health. This document was initiated by the OECD Working Party on Manufactured Nanomaterials (WPMN) Steering Group 8 (SG8), whose members also provided a lot of contributions. This document is to be seen as one element within the frame of exposure mitigation in the handling of a wide range of nanomaterials with a large variety of production and manufacturing procedures. The insight in the state of the art of good practice for nanomaterials in laboratories may not only be important for research laboratories, but it can furthermore be of great interest for small and medium industrial enterprises, which produce or process nanomaterials in a laboratory scale. A compilation of literature with appropriate measures will provide support for the exposure mitigation and therefore generally for the occupational safety and health. The comparison focusses mainly on category S guidelines since an enormous number of nanomaterials are processed at a research level. The statements of these guidelines are supplemented by guidelines from category G and L if they provide additional information in order to avoid a high degree of redundancy.

Category S(pecific): specific nanomaterial guidelines relating to laboratories,
Category G(eneral): general nanomaterial guidelines with regards to laboratories,
Category L(aboratories): general laboratory guidelines applicable to nanomaterials.

Typical concepts of occupational safety required by compiled guidelines:

- **Precautionary approach** (new substances, which are insufficiently examined for their properties)
- **Classification** (profile of potential toxicity based on several factors like morphology, size, surface, solubility, mass...)
- **Risk assessment** (diverse opinions on the general contents of the risk assessment)
- **Physical hazards** (catalytic effects, flammability, explosivity, pyrophoricity, electrocution...)
- **Safer manufacturing approaches** (form of appearance, type of process; substance if technically feasible)
- **Technical measures** (closed system (fume cupboard, biological safety cabinet...), local exhaust ventilation; ventilation system in working area)
- **Organisational measures** (access control, mitigation of exposure, surveillance, area for changing clothes...)
- **Labelling** (properties not mandatory associated with hazard assumption; labelling required for in-company handling since criteria for nanoproperties itself are missing)
- **Personal training** (broad range of possibilities for information and training of the employees working with nanomaterials)
- **Cleaning** (routine cleaning, cleaning in case of contamination, cleaning hygiene of the employees)
- **Personal protective equipment** (respiratory protection, gloves, safety glasses or shields, laboratory coats...)
- **Medical surveillance** (health monitoring to detect any health effects at an early stage)
- **Transport** (like normal chemicals, i.e. in closed, labelled containers)
- **Waste disposal** (as hazardous waste with consideration of the chemical properties of the respective nanomaterial)
- **Documentation** (documents in the laboratory area (laboratory safety plan, standard operating procedures...), recommended documentation (incidents, training, exposure, performed tests, protection measures, nanomaterial properties...))



Figure: Nanoparticle (Nico Dziurawitz and Sabine Plitzko, BAuA)

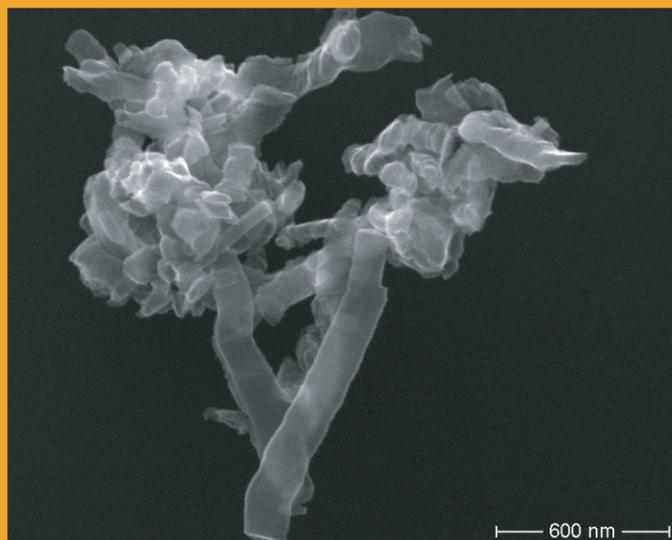


Figure: Nanofibre (Nico Dziurawitz and Sabine Plitzko, BAuA)

Conclusions

In this compilation, a broad overview of recently published literature should be provided since no globally standardized protection measures for handling nanomaterials are determined yet. The content and structure of the analysed guidelines is primarily based on typical concepts of occupational safety and health. The various aspects, which are mentioned in these guidelines, refer to the precautionary approach, classification, assessment of nanospecific and physical hazards, measures according to the STOP principle, medical surveillance, transport, waste disposal and documentation of the taken measures.

The reported opinions on the majority of aspects agree on many points. As an example, it is generally regarded as essential to use precautionary measures to minimize risk in laboratories. Further aspects, which are regarded to be essential, refer to the general application of risk assessment, substitution, technical and organizational measures and personal protective equipment. However, a large variation exists regarding several aspects like classification, risk assessment or respiratory protection. Additionally, singular noticeable opinions on several aspects have been detected.

One can conclude that the reviewed guidelines mainly agree in the basic issues of occupational safety with respect to nanomaterials in laboratory scale. These issues can therefore be regarded as consolidated agreement. In other aspects, a large range of recommendations can be found. The suggestions on the one side of the range, where lesser protection measures are mentioned, are possibly more suited to deal with low hazard nanomaterials. Some very specific remarks appear only sporadically and hence should be regarded carefully. They provide very detailed informations, which might be helpful to determine precise measures. Since the level of abstraction in the guidelines is generally high, in-company realisations of the suggestions still have to be accomplished.