Fabrication of Lightweight Aluminium Metal Matrix nano-Composites and Validation in Green Vehicles

FLAMINGo

Safety to Nanomaterials in the Workplace: General Guidelines

FLAMINGo in Brief

The FLAMINGo project aims to develop a highly efficient production of advanced multi-materials with a nanocomponent and introduce them in the conventional metallurgical and forming industrial technologies for production of electric vehicle components. The assessment of FLAMINGo's engineered nanomaterials contribution to the pre-existing occupational exposure have been assessed from formulation to the recycling phases of the advanced multi-materials. Risk management strategies have also been proposed to limit the risks identified. Note that natural and/or incidental nanomaterials may exist already in workplaces when high-energy processes are involved.

What are nanomaterials?

According to the European Commission, Nanomaterials are natural, incidental or manufactured/ engineered materials consisting of solid particles existing as their own or in aggregates or agglomerates forms[1]. Natural and anthropogenic (engineered and incidental) nanomaterials can be grouped according to their major application/use.

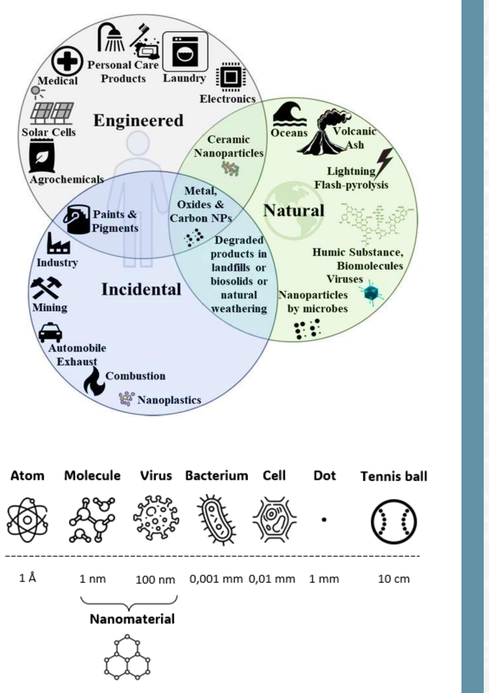
For a material to be classified as nanomaterial, 50 % or more of the particles in the number-based size distribution must fulfill at least one of the following conditions:

- One or more external dimensions of the particle are in the size range of 1nm to 100nm;
- The particle has an elongated shape, such as a rod, fibre or tube, where two external dimensions are smaller than 1 nm and the other dimension is larger than 100 nm;
- The particle has a plate-like shape, where one external dimension is smaller than 1 nm and the other dimensions are larger than 100 nm.

[1] Commission Recommendation of 10 June 2022 on the definition of nanomaterial. 2022/C 229/01. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022H0614%2801%29

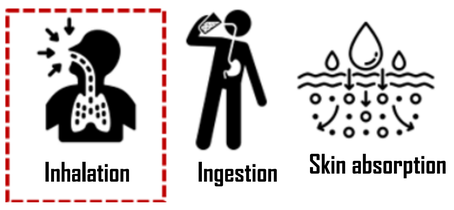
[2] Malakar et al., (2021). doi: 10.1016/j.scitotenv.2020.143470.

[2]



Exposure routes to human beings

During nanoparticles life cycle, human beings can be exposed via inhalation, dermal penetration and ingestion. Along the different stages of materials' use, it is in occupational settings where the highest risk of exposure to engineered nanoparticles can be found, which can lead to serious health effects in a medium to long term.



Main exposure route

[3]

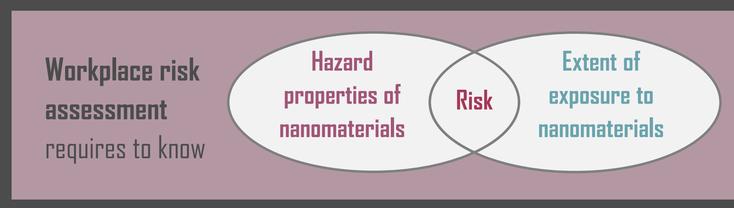
Workplace source releases

Critical activities

- **High energy processes:** physical and chemical synthesis, machining, abrasion, mechanical;
- **Ordinary handling:** weighing, mixing, transferring, packaging, cleaning, maintenance.

Risk assessment methodology & regulations

If nanomaterials are present in the workplace, the employer shall assess any risks to the safety and health of workers. The assessment of hazards and risks associated with nanomaterials should be carried out on a case-by-case basis.



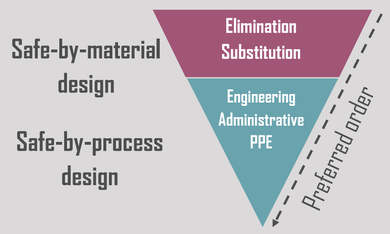
In the European Union (EU), nanomaterials are covered by the same regulatory framework that ensures the safe use of all chemicals and mixtures, i.e. REACH and CLP regulations. The EU legislation and the generic rules established, apply in the same way to nanomaterials, as well as to other form of substance, despite not referring explicitly to them. Therefore, hazardous properties of nanoforms of substances must be assessed and their safe use needs to be ensured.

Several organisations have been developing research activities with specific relevance for regulatory issues related to nanomaterials.

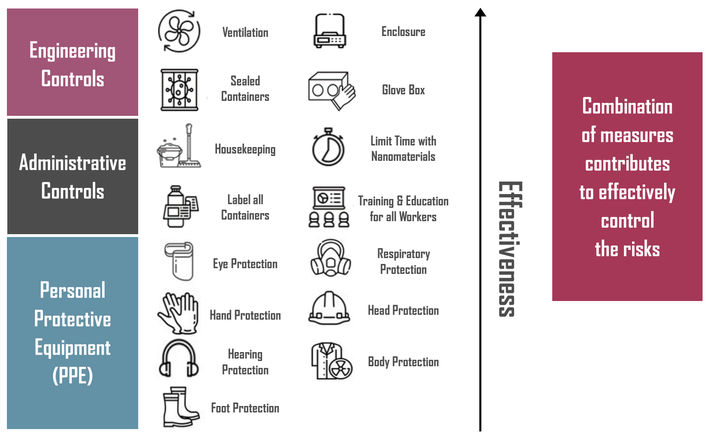
Risk control strategies

Limiting exposure to risks at work is essential for worker protection. The optimum course of action for controlling exposures can be established via the hierarchy of controls, i.e.

1. Safe-by-material design/ Hazard/ Toxicity control: Modification of nanomaterial properties while maintaining their functionality;



2. Safe-by-process design/ Exposure control: Reduce the release of nanomaterials from industrial processes or limit the exposure of workers.



As a preventive safe-by-material design measure, nanomaterial powders were embedded in a matrix in the FLAMINGo formulation phase, since a matrix containing nanomaterials represents a low level of human exposure (except if they are subjected to cutting or grinding processes).

Safe & Sustainable by Design (SSbD) framework

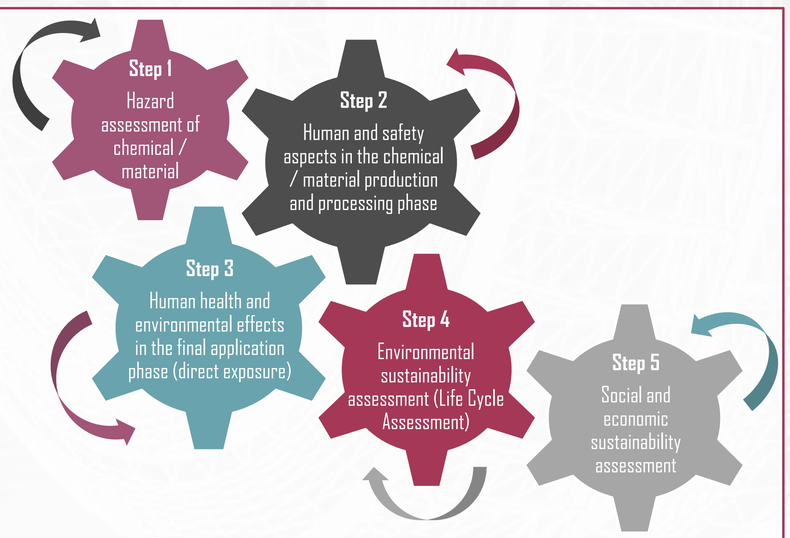
Holistic & systematic approach

SSbD framework aims to support the design and development of safe and sustainable chemicals and materials throughout their entire life cycle, considering a hierarchical and iterative assessment of 5 steps. Each step has their own aspects, indicators, criteria and an evaluation (scoring) system to achieve a SSbD level.

Design principles should be established in the beginning of the assessment to maximise the possibilities of achieving a successful safety and sustainability assessment outcome. Examples of design principles are material efficiency; minimise the use of hazardous chemicals and materials; design for energy efficiency; use renewable sources; prevent and avoid hazardous emissions; design for end of life; consider the whole life cycle.

The application of the SSbD framework to case studies has been developed by the Joint Research Centre (JRC) of the European Commission, in a partnership with industrial stakeholders.

For more information, please access the European Commission's website: https://environment.ec.europa.eu/topics/chemicals



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