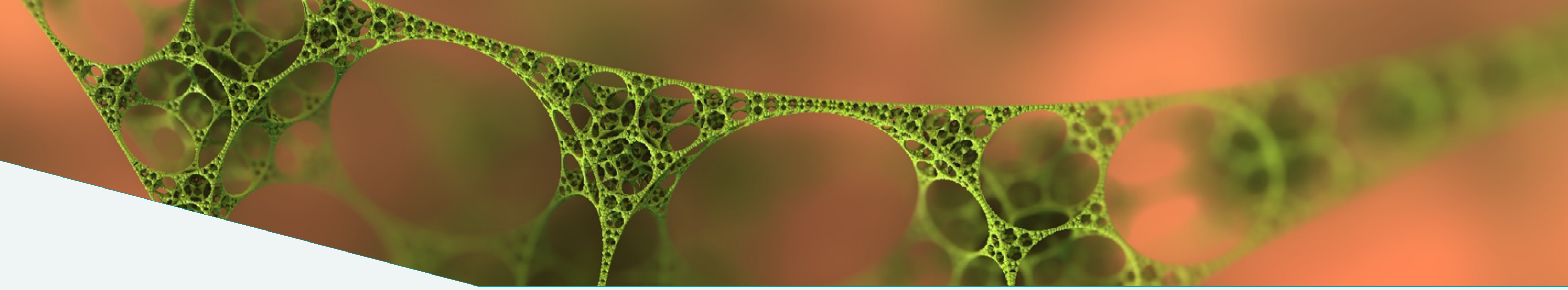


Case study on „Nanotechnologies“

Case study introduction

Because of their high variability and universal use, nanotechnologies are among so called key enabling technologies (KET), the others being advanced materials, advanced manufacturing and production technologies, and biotechnology. It is obvious that nanotechnology is not "one" technology but is getting more and more important in a vast majority of technological sectors.

Relevance to the precautionary principle

New technologies like nanotechnology and advanced materials (emerging technologies) are defined by uncertainties rather than risks (lack of data and analytical methods, lack of long-term experience, scientific ambiguities, terminological vagueness, etc.). Therefore, an appropriate regulation of emerging technologies is not necessarily risk management, but more the management of uncertainty depending both on the quality of the available information and on the willingness of people with very diverging interests and motives to co-operate in the production of reliable knowledge on the behaviour of nanomaterials. From an early onset, the European Commission propagated an "integrated and responsible approach" on nanotechnology in its Nanoscience and Nanotechnology Action Plan of 2005 based on the precautionary principle.

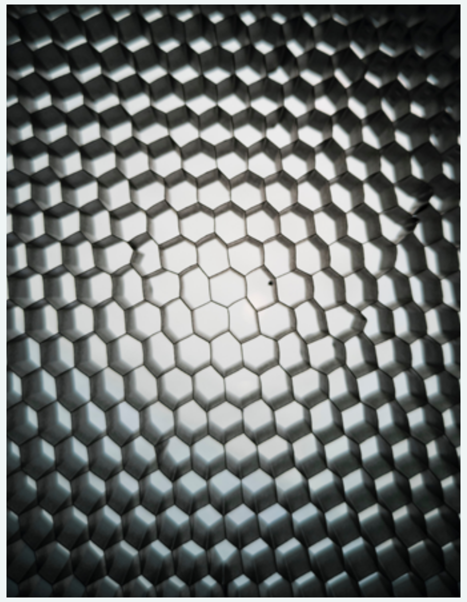
Consequently, national action plans of the Member States (Germany, Austria, and Switzerland) are to this day implementing regulatory measures such as safety research programmes, standardisation projects or the establishment of evaluation processes and commissions to integrate safety issues into innovation at an early stage.

Potential impact

Nanomaterials and their various use in complex compound materials, as well as nanotechnological production methods, offer a vast range of innovative solutions to many problems. The areas of application range from the automotive and aeronautics industries (lighter but more robust materials), new construction materials (reduction of brittleness and increase of resilience against pressure and shear forces), and surface treatment (functionalisation of cell membranes and integration of electrochemical functions into biological structures), to the design of new drugs and drug delivery mechanisms and specific diagnostic and therapeutic devices.

On the other hand, the nano-safety research shows that some nanomaterials can have negative effects on health and the environment, such as respirable asbestos-like particles and fibres. Although more recent studies primarily address environmental interactions and transformation processes significantly influencing toxic effects (e.g. particle agglomeration, dissolution), there is still a paucity of information and discrepancies in literature about environmental impacts of nanomaterials. Their handling and destiny in waste streams brings additional aspects into the research field which have to be considered.

There is uncertainty about nanotechnologies and advanced materials, which makes the definition of risks difficult. Why? While risks allow knowledge on possible outcomes and an expression of probabilities, uncertainty does not allow the assignment of probabilities to outcomes.



Key uncertainties

The main source of uncertainty is the sheer complexity of the whole field. Nanotechnological substances and compounds can be formed from more than 50 different chemical elements, the most common being silicon, titanium, carbon and metal oxides. In the case of carbon, the number of possible chemical compounds is almost unlimited.

Apart from the chemical variety, each nanoparticle can and has to be described by more than a dozen different physical attributes which are effective at the nanometer level.

Given the fact that, at this size level the physical properties are more relevant regarding the behaviour (positive and negative), the most important field of uncertainty concerns the definition and adaptation of suitable detection and measurement methods and protocols.

Interesting links

- Nanotrust: www.oeaw.ac.at/en/ita/projects/current-projects/nanotrust
- Nanotechnology: ec.europa.eu/jrc/en/research-topic/nanotechnology
- European Union Observatory for Nanomaterials: euon.echa.europa.eu

Further information

Austrian Academy of Sciences
Institute of Technology Assessment
www.oeaw.ac.at/en/ita

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For the **references** used for the case study, please look into the full report available at: www.recipes-project.eu/results/case-study-5-nanotechnologies

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