Toxicology and Ecotoxicology, human and ecological risk assessment of engineered nanomaterials: needs, goals and tools/methods for safer-by-design strategies

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Nanomaterials, nanoproducts and nanotechnologies, included among the Key Enabling Technologies and the green innovations, attracted, in the last 10 years, a lot of public and private resources for the development of new commercial products. However, only when these are near commercialization, discussions about human and environmental safety threaten the investments because industry and regulatory authorities have a different opinion. Besides, there is no consensus inside the scientific community about the toxicity of Engineered NanoMaterials (ENMs: metallic and carbon-based nanomaterials including nanoplastics) to human and the environment. The fact that there are so many ENMs (with different size, shape, coatings, physicochemical properties,...) does not help to clarify this issue. Achieving safer-by-design ENMs requires a deep understanding of their intrinsic properties and the understanding of the behavior and the effects of these materials in the environment and in living systems. Industry needs clear regulations on safety and regulators ask for more data to support the safety assessment. A central point to fill this gap is to identify the common basic needs for the Environment and Human Health Safety (EHS) assessment during the design, production, use and end of life phases of engineered nanomaterials and nanoproducts/nanotechnologies. This can be obtained through the integration of, still separated, safety assessment methods into an unified approach, which needs to be developed and implemented in collaboration with industrial engineers taking into account innovation and competitiveness issues. The stimulation of trans-disciplinary collaboration between different research areas (physics, chemistry and biology) and between scientific research and market needs, to improve EHS assessment, is the aim of this session. In this context, the session focuses on: • New evidences of the key physicochemical parameters which drive the toxicity and eco-toxicity of ENMs to both human health and environment; • Effect of abiotic and biotic transformations of ENMs on their intrinsic toxicological properties and the effect of co-exposure of ENMs with other classes of pollutants; • Routes of exposure and internalization. If accumulation is an issue, the study of food chain transfer is of outmost interest: ecologic assessment using single-food chain as a basic approach and if possible, increasing complexity using mesocosm studies; • Studies which use novel approach for defining the toxicity of ENMs as High Throughput Screening (HTS) and wide screening assays; • Predictive tools based on structure-activity relationship of nanostructures (materials) within biological and ecological matrices to advance cost-effective and environmentally benign processes and engineering solutions over full life cycles; • Case studies on integrated research to construct and test a safe-by-design (SbD) approach; • Study of current nano-consumer exposure scenarios and improvement based on the identified chemical and physical properties throughout Environmental and Human Risk assessment, management and communication; • Life cycle Thinking and Assessment (LCT, LCA) approach, to assess technology and safety issues, to reduce the risk for both environment and the whole society. Platform presentations will endorse in particular the integration or combine use of these assessment methods to evaluate EHS of the nanoproducts/nanotecnologies.