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CV/ biography

Prof. Dr. Bernd Nowack holds a MSc. (1992) and a PhD (1995) in environmental sciences from ETH Zürich. After research stays at the Johns Hopkins University in Baltimore, USA, Eawag and ETH Zürich, he is leading since 2007 the "Environmental Risk Assessment and Management" group at Empa, the Swiss Federal Laboratories for Materials Science and Technology. He is also adjunct professor in the Department of Environmental Systems Science at ETH Zurich. His current research deals with the environmental risks of engineered nanomaterials, nanobiomaterials and microplastics, comprising a wide spectrum of different approaches, e.g. material flow modeling, environmental risk assessment; experimental studies about release from products. He has published 185 peer-reviewed publications and has an h-factor of 68. He acted as co-advisor of 25 PhD projects, is co-Editor-in-Chief of *NanoImpact* and Associate Editor of *Environmental Pollution*. He is listed since 2014 each year as “Highly Cited Researcher”.

Advances in environmental risk assessment of engineered nanomaterials

For a quantification of the environmental risks of engineered nanomaterials (ENM), information on both hazard and exposure needs to be available. Whereas many ecotoxicological studies provide data for hazard assessment, no specific measurements of ENM in environmental systems are available. Modeling has therefore been used since many years to obtain environmental exposure information. Recently several improvements of material flow models have increased our confidence in the results of these models: the inclusion of dynamic aspects and the separation of the flows into different forms of ENM. Dynamic material flow analysis is able to quantify the accumulated ENM amount in environmental sinks and can be used to predict future emission scenarios. Most existing models for assessing the releases of ENMs into the environment are based on the assumption that ENM remain in their pristine forms during their whole life cycle. It is known, however, that this is not always the case as ENMs are often embedded into solid matrices during manufacturing and can undergo physical or chemical transformations during their life cycle, e.g. upon release to wastewater. We therefore developed a method to systematically assess the forms in which ENM exist throughout their life cycle.

The improved material flow models provide a starting point for quantitative environmental risk assessments. A form-specific assessment resulted in predicted environmental concentrations for anatase vs. rutile nano-TiO_2, single-wall vs. multi-wall CNTs and α- vs. γ-nano-Al_2O_3 that varied by a factor of 2 to 13. Additionally, the material-specific predicted no-effect concentrations for the nano-forms were derived.

For nanocellulose, a prospective environmental risk assessment was performed, indicating that by 2025 there is no environmental risk within the surface water compartment, even assuming a compound annual growth rate of 19% for nanocellulose production in upcoming years.

Coupling the form-specific flow assessment with form-specific hazard assessments, a first specific risk assessment for different released forms of nano-Ag, nano-ZnO and nano-TiO_2 could be obtained, i.e. considering pristine, dissolved, transformed, and matrix-embedded forms.

Keywords: engineered nanomaterials, environmental exposure, environmental risk assesment