**Comparing fate and behavior of engineered and natural nanomaterials**

Stephan Wagner, Andreas Gondikas, Elisbeth Neubauer, Thilo Hofmann, Frank v.d. Kammer

University of Vienna, Department of Environmental Geosciences, Althanstraße 14, UZA II, 1090 Vienna, Austria [frank.kammer@univie,ac,at](mailto:frank.kammer@univie,ac,at)

There is no doubt that the development and application of nanotechnology will lead to the emission of engineered nanomaterials (ENMs) into the environment. The ongoing discussion on the assessment of this release is mainly concern-driven because NMs exposure may have adverse effects on the ecosystem and biota. In order to quantify this risk, information on the fate and behavior of ENMs is required and it is also critical to determine whether these new materials are significantly different than their natural counterparts. The comparison of naturally observed processes with those studied for engineered materials may help to identify the "nano-specific" properties of ENMs. Therefore this literature based study aimed at the identifying differences in fate and behavior of engineered nanomaterials and natural colloids in terms of (I) surface modifications, (II) particle transport, and (III) dissolution. Consequences were derived for the assessment of the fate and behavior of ENMs in the aqueous environment.

Literature data indicates clearly that persistent organic coatings and core–shell structures differentiate ENMs from their natural counterparts through their surface transformations. Transformations of the NP coating modify the NP fate and behavior, since they control the NP flocculation and deposition. Another potential route to breaking down the coatings is biologically mediated transformation, for example, by biodegradation of polymer coatings covalently bound to nanomaterials [1]. Irrespective of the degradation mechanism, studies showed that the loss of the coating leads to aggregation of the particles [2]. As the knowledge on the persistence of those coatings is still underdeveloped the influence of surface modification or specific coatings cannot fully be assessed at the current state of knowledge. Therefore laboratory tests are required to determine the fate of the coated or surface modified nanomaterials. Taking into account typical (long) residence times of ENMs in the environment, the existing scientific information on kinetics of dissolution and transformation processes and the nature of the transformation products suggests to treat bare NP’s (engineered or natural) similar to their respective granular bulk materials.

From the state-of-the-art knowledge, we developed a conceptual decision model for determining whether engineered nanomaterials differ from their natural counterparts in terms of environmental fate. In cases where there is evidence of a distinct behavior, the concept provides suggestions for laboratory tests which are required to determine the fate and behavior of the specific ENM. This concept provides a relevant contribution to the grouping approach recently developed and published by the ECETOC ‘Nano Task Force’ [3].

Acknowledgement - This work was supported by the DetectNano project supported by the Austrian Science Fund (FFG, no. 8357508) and the German Chemical Association (VCI e.V.).

**References**

[1] Kirschling T, Golas P, Unrine JM, Matyjaszewski K, Gregory KB, Lowry GV, Tilton RD. 2011. Microbial Bioavailability of Covalently Bound Polymer Coatings on Model Engineered Nanomaterials. *Environ. Sci. Technol.* 45 (12), 5253–5259.

[2] Auffan M, Pedeutor M, Rose J, Masion A, Ziarelli F, Borschneck D, Chaneac C, Botta C, Chaurand P, Labille J, Bottero JY. 2010. Structural Degradation at the Surface of a TiO2-Based Nanomaterial Used in Cosmetics. *Environ. Sci. Technol*. 44 (7), 2689–2694.

[3] A decision-making framework for the grouping and testing of nanomaterials (DF4nanoGrouping). 2015. Arts JHE; Hadi M, Irfan M-A, Keene AM, Kreiling R, Lyon D, Maier M, Michel K, Petry T, Sauer UG, Warheit D, Wiench K, Wohlleben W, Landsiedel R, *Regul. Toxicol. Pharmacol.*, http://dx.doi.org/10.1016/j.yrtph.2015.03.007