Sorption of engineered silver nanoparticles to environmental and model surfaces

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The fate of engineered nanoparticles in the environment is strongly determined not only by their tendency to form homo- or heteroaggregates but also by their interaction with environmental surfaces like plant leaves, soil particles, sediments or biofilms.

In this study we are investigating the deposition behavior of silver nanoparticles to model and environmental surfaces and to understand the role of particle-surface interaction forces for the quality and quanity of nanoparticle deposition.

Surface-nanoparticle interactions were investigated in batch experiments via equillibrium sorption isotherms to various natural and model surfaces. The model surfaces were chosen to cover a wide range of intermolecular interactions considering van-der Waals interactions as well as proton donor and acceptor interactions.

All the sorption isotherms for sorption of silver nanoparticles to different model surfaces were described best by Langmuir sorption. The Langmuir adsorption coefficient is controlled by the chemical nature of the model surfaces used.

The sorption study was accompanied by atomic force microscopy (AFM) on a qualitative and a quantitative basis for assessment of morphology and nanomechanical parameters of the covered surfaces.

In this contribution, we will discuss the physicochemical aspects of sorption and deposition of silver nanoparticles on environmental surfaces and the resulting environmental effects with special respect to quantitative aspects of sorption and interaction.

The geoengineering possibilities and impact of enhanced silicate weathering in the ocean

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Geoengineering methods are being explored to counteract global warming effects on Earth's climate. The use of enhanced silicate weathering has been proposed as a method that could speed up the consumption of CO_2 by enhancing naturally occurring chemical weathering. This study investigates that method, which involves grinding, dispersing and dissolving olivine, a magnesium silicate mineral, in river catchments and over the open ocean in order to absorb excess CO_2 and oppose ocean acidification. Previous research shows that if olivine is distributed over land areas of the tropics, it has the potential to sequester as much as 1 Pg C yr^{-1} leading to a reduction of global warming by 1 K and a rise in sea surface pH by 0.1 by the year 2100 [1]. Here, different olivine distribution scenarios over the ocean are examined using the REcoM-2 biogeochemical model coupled to the MITgcm ocean general circulation model. The additional distribution of finely ground olivine over the open ocean could increase the amount of carbon sequestered. Extra input of silicate could create better growing conditions for large silicon dependant diatoms, which contribute largely to the export of organic matter. In this study, we calculate the additional contribution and consequences of olivine distribution. As one of the least expensive geoengineering methods, enhanced weathering is a promising option to help contribute to the efforts to reduce the effects of climate change. However, this can cause both intentional and unintentional changes to the climate that may have potentially important consequences on the Earth's ecosystems.

[1] Köhler, P., Hartmann, J., Wolf-Gladrow, D. (2010). *Proc. Natl. Acad. Sci. USA* **107** 20228– 20233.