Engineered Nanoparticle Interactions with Suspended Colloids Determine Their Environmental mobility and fate

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The highly dynamic behavior of engineered nanoparticles (ENPs) in environmental systems and their interactions with natural colloids results in a set of chemical and physical transformations including dissolution, heteroaggregation and sedimentation. The mechanistic understanding behind these physicochemical processes is critically needed for the development of exposure models.

This study aims to understand the behavior of 10 different sized and manufactured coatings Ag nanoparticles (NPs) dispersed in different aquatic media in absence and presence of natural organic matter (NOM; 7 different fractions were used). The use of 5 different synthetic freshwaters, and 3 natural waters collected from Seine River watersheds with distinct land use, allowed to evaluate the impact of dissimilar water components on the NPs fate. Dissolution, heteroaggregation and sedimentation was followed during 1 month.

The results in the synthetic waters show that the interaction between these NPs and NOM rules their mobility and fate. The dissolution of these NPs when in presence of NOM decrease from 40-60 % (dependent on the NP type) to lower than 6% (for all NPs), indicating that the free Ag ion will not account for the bioavailability as thought until now.

The performed kinetic studies showed overall effects on the agglomeration and sedimentation profiles of Ag NPs, dependent on the water composition, however without significant correlations between these parameters. Lower rates were obtained when in presence of NOM, with correlations for the NOM molecular weight.

The conclusions obtained with the synthetic waters are being now validated with natural waters, and the obtained results will be thoroughly discussed in the presentation.

It can already be foreseen that it will be very difficult to make general rules on how different particles can behave in presence of different media. Evidently, this will greatly impact on how to establish models that will be able to predict their behavior and fate, and even on the grouping and similarity exercise needed to foresee their fate. This work is part of the GUIDEnano Project (EU FP7).