The Environmental Fate of Engineered Nanoparticles in Lake Geneva Water

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ISE Environment Day , 4th December 2015

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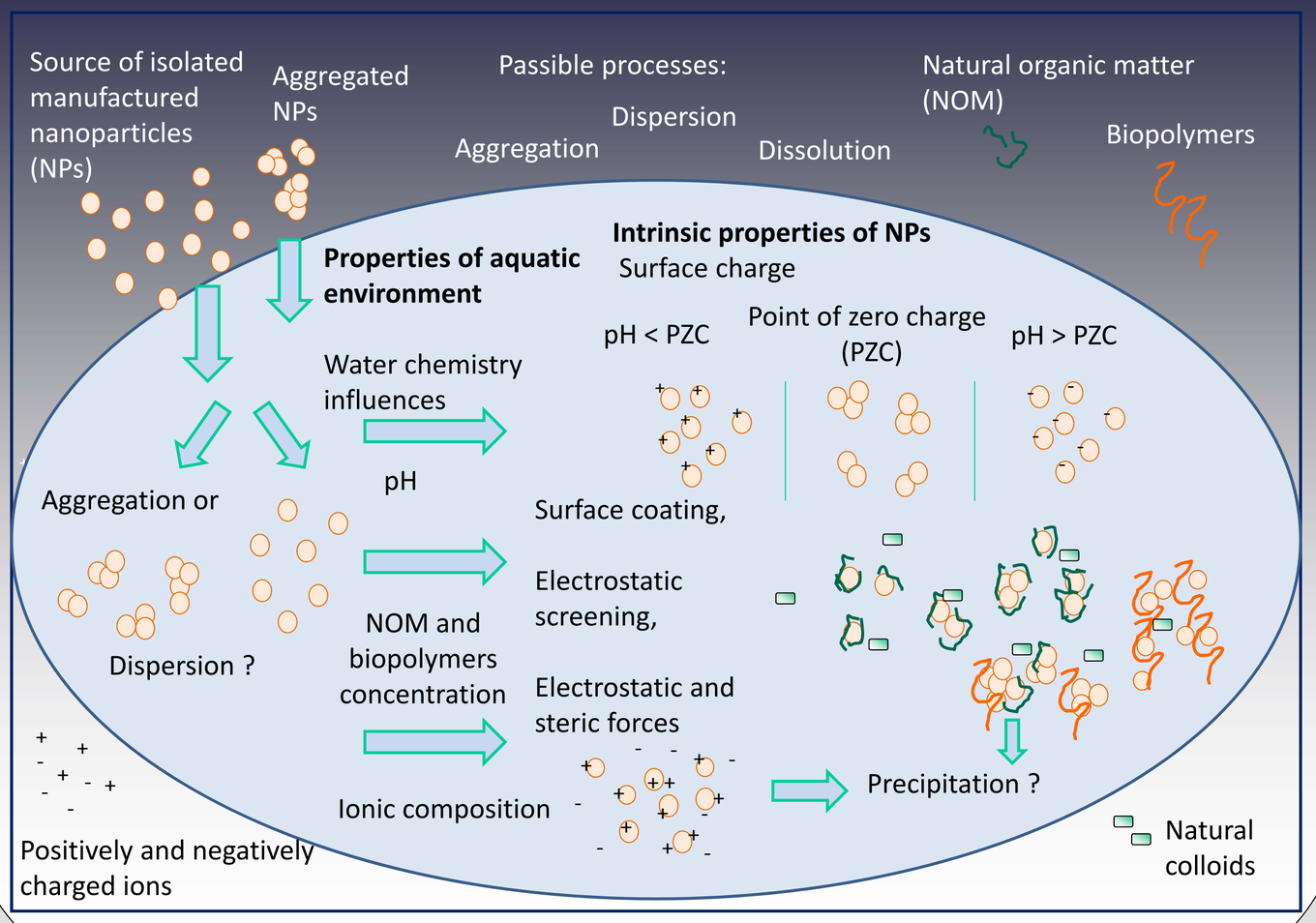
Introduction

Cerium dioxide nanoparticles (CeO_2 NPs) are widely used in many consumer products due to their catalytic and oxidative properties. The growing consumption of such products is constantly increasing the presence of CeO_2 NPs in the environment, including natural water sources such as rivers or lakes. Despite the number of researches which have been conducted in this area, the fate of CeO_2 NPs in aquatic systems isn't clearly understood

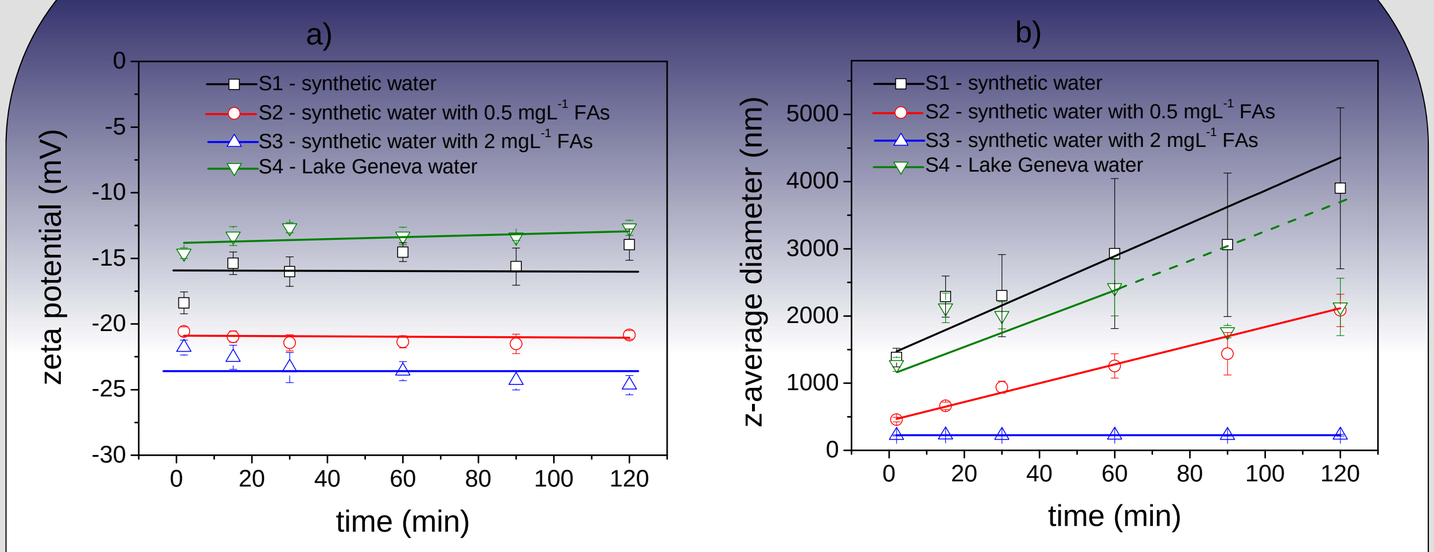
Nanoparticles fate and behavior in natural fresh water



Materials and Methods

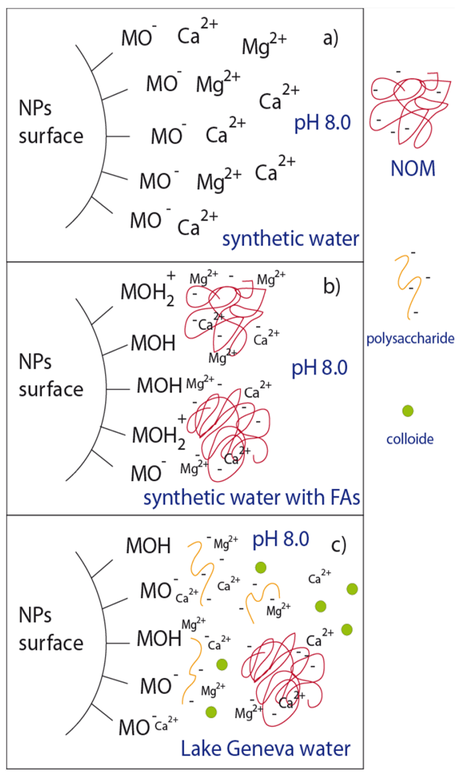
- **CeO_2 NPs (NM-212)** Uncoated from JRC repository (NanoMILE project), Average particle size : 28.4 ± 10.4 nm (manufacturer), Specific Area : 27.8 ± 1.5 m^2/g (BET)
- **FAs** Type: Suwannee River Standard II (2S101F) purchased from International Humic Substance Society, USA
- **DLS:** A Malvern Zetasizer Nano ZS was used to determine the zeta potential and z-average hydrodynamic diameter of the CeO_2 NPs
- **SEM:** A JEOL JSM-7001FA was used for image analysis

Stability of CeO_2 NPs in synthetic and natural waters



(a) Variation of zeta potentials and (b) z-average hydrodynamic diameters with time in different water samples

Effect of NOM, natural colloids and ionic strength on stability of CeO_2 NPs



Schematic representation of the processes occurred when NPs released in various water samples

SEM images of CeO_2 NPs in different water samples:

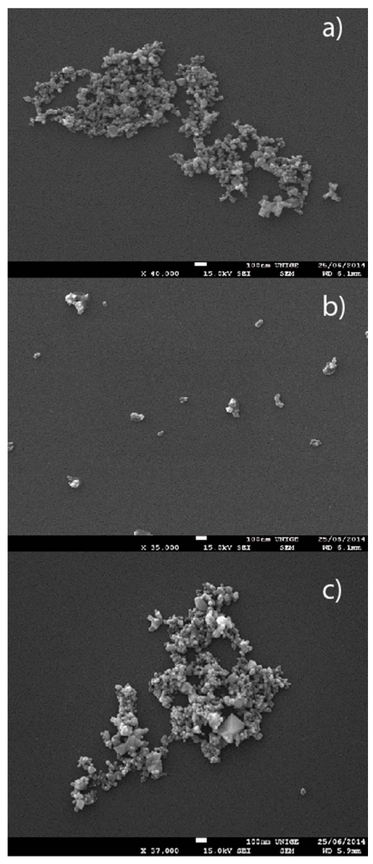
a) synthetic water;

b) synthetic water with 2 mgL^{-1} FAs;

In the presence of FAs NPs are stabilized and the size of aggregates is equal to 200 – 250 nm

c) natural Lake Geneva water

In synthetic water and in natural Lake Geneva water NPs are found aggregated and implemented in a matrix made from natural organic matter and salts



Conclusions

- pH, ionic strength and coating with natural organic matter play an essential role on the CeO_2 NPs behavior in the aquatic environment
- The presence of excess of FAs leads to the kinetic stability of CeO_2 NPs in model systems as ultrapure and synthetic water
- Presence of natural colloids, such as natural organic matters, polyelectrolytes, polysaccharides, biopolymers, iron oxy-hydroxide and inorganic particles in natural Geneva Lake water results in CeO_2 NPs aggregation

Reference

Oriekhova, O., Stoll, S., 2016. Effects of pH and fulvic acids concentration on the stability of fulvic acids – cerium (IV) oxide nanoparticle complexes. Chemosphere 144, 131–137. doi:10.1016/j.chemosphere.2015.08.057

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