What transformations for engineered nanoparticles at the biofilm/mineral interface

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The increasing use of Quantum Dots (QDs) - nanoparticles exhibiting unique optical properties – and their incorporation into numerous engineering products is expected to result in the significant release of this new class of contaminants in the Environment. In soils, microbial biofilms and mineral surfaces form highly reactive interfaces, that may be able to control the QDs environmental fate. Still, QDs stability and modes of interactions with biofilm/mineral interfaces remain poorly defined. This work describes the interactions, distributions and stability of thioglycolic acid-capped CdSe/ZnS QDs at the corundum (α-Al_2O_3)/*Shewanella oneidensis* MR-1/solution interface, for exposure times ranging between 1h to 24h. To do so, Long Period – X-ray Standing Waves – Fluorescence Yield spectroscopy and Grazing Incidence – X-ray Absorption Spectroscopy are used.

Results show a significant increase in Zn and Se trapping within the biofilm/mineral interface with time, demonstrating its high accumulation potential over 24h. Also, the fast dissolution of a significant part of the ZnS shell occurs within 1h, indicating a potential QDs degradation when exposed to the biofilm/mineral interface, with the loss of Se and Zn co-localization. Once released, Zn(II) migrates toward the biofilm basis and interacts preferentially with the mineral surface. Meanwhile, the remaining CdSe core is mostly preserved, and stays associated with the biofilm. However, at 24h, Se and Zn present similar distribution profiles, thus indicating a lowered ZnS shell dissolution at longer times of exposure, wich could be the result of changes in microenvironments local conditions in the biofilm thickness.