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Abstract

The Interaction between Extracellular Polymeric Substances from Diatom *Cyclotella meneghiniana* and Citrate-Coated Silver Nanoparticles †

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Opposite to the significant knowledge about the toxicity of AgNPs to phytoplankton species, rather limited knowledge is available about the role of phytoplankton secretions such as extracellular polymer substances (EPS) in NPs' fate [1]. This study, therefore, explores the interaction between 20 nm citrate-coated AgNPs (Cit-AgNPs) and the EPS derived from the diatom *Cyclotella meneghiniana*, and, in particular, their colloidal stability and transformations. To this end, a combination of different state-of-the-art techniques was employed to characterize the AgNPs-EPS interactions: Asymmetric Flow Field-Flow Fractionation (AF4) coupled with ICP-MS, Dynamic Light Scattering (DLS), Zeta Potential, and Surface Plasmon Resonance (SPR) absorbance spectroscopy. The changes in the size distribution, surface properties, and stability of Cit-AgNPs (4 mg/L) in the presence of various concentrations of EPS (130, 65, 32.5, and 13 mg C/L) were studied in both short-term (0–2 h) and long-term (72 h) experiments. The results showed that EPS stabilizes Cit-AgNPs, presumably through the formation of an ecocorona. The interaction occurred rapidly in the short term, leading to long-term stabilization, as revealed by the changes in the SPR-UV-Vis spectrum, characterized by the appearance of a typical shoulder associated with AgNPs' aggregation/agglomeration and alterations in hydrodynamic diameter. In the presence of EPS, the surface charge (zeta potential) of the Cit-AgNPs also shifted towards values similar to those of EPS alone, indicating an interaction. The EPS reduced the dissolution of Cit-AgNPs after 24 h. AF4-MD-ICP-MS provides relevant information with respect to DLS and UV-Vis spectroscopy, confirming the change in size of the Cit-AgNPs, the stabilization in the long term, and the interaction with the EPS. Taken together, the results of this study demonstrate that the EPS derived from the diatom *Cyclotella meneghiniana* modifies the surface properties and stability of 20 nm Cit-AgNPs. Therefore, such interactions have to be taken into consideration for predicting the fate and effects of Cit-AgNPs in the environment.

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Reference

1. Chetwynd, A.J.; Lynch, I. The Rise of the Nanomaterial Metabolite Corona, and Emergence of the Complete Corona. *Environ. Sci. Nano* **2020**, *7*, 1041–1060. [CrossRef]