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MICROBIAL PRODUCTION OF SELENIUM NANOPARTICLES: ROADMAP TO RECOVERY AND REUSE

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Abstract

In the view of increasing scarcity of metals, in particular those used in emerging technologies, industrial waters containing selenium should not anymore be considered a "waste", yet an indispensable selenium resource of the future. Still, recovery and reuse selenium from industrial wastewaters is not a trivial task. Specialized microorganisms, so called dissimilatory metal reducers, can indeed be used to convert water soluble, toxic selenium compounds (selenite, selenate) to water insoluble, non-toxic elemental selenium. However, the separation of this solid produced from the aqueous phase is challenging due to the fact that the solid products formed are–although pure elemental selenium- of nanoparticle size. So far, this circumvented recovery by simple (and thus cheap) gravitational settling. Here we show that the nanoparticulate size and the poor settleability of the solid products formed is due to an organic polymer fraction associated. We used capillary liquid chromatography-electrospray ionization-tandem mass spectrometry (LC-ESI-MS/MS) to identify proteins associated. We could demonstrate that these proteins strongly associated to selenium surfaces, not only microbially produced but also by chemical synthesis. Furthermore, we studied the influence of the organic polymers associated on the colloidal stability of the nanoparticulate suspensions by means of electrophoretic measurements (i.e. zeta –potential). The results gained can be directly used to enable selenium nanoparticle recovery by cheap gravitational settling. This represents and vital way point towards the recovery of nanoparticle elemental selenium from industrial "waste" waters.