# Mechanisms of BioSeNPs biomineralization: AFM, FTIR and XPS analysis

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Extracellular biogenic elemental Se nanaoparticles (BioSeNPs), usually in red spherical amorphous forms (a-Se) rather than large crystals (t-Se), are the main biomineralization forms of Se oxyanions induced by microbes. Although it is considered specific morphologies and properties of BioSeNPs are controlled by biomolecules and their metabolism process, however, a fundamental understanding of the interactions between molecules, clusters, and/or $Se^0$ particles in a growth medium are poorly understood[1]. Here, we explored the mechanism by analysing structures and compositions of the minerals at mesoscopic scales.

AFM captured images of 10-20 nm extracellular granules when culture started to turn red with ion nucleation, and then the SeNPs act as seeds for further growth to 100- 200 nm particles with time to the end of exponential growth, and finally aggregated to 500 nm in late stationary phase. Unlike black t-Se, larger elastic modulus was present for the amorphous BioSeNPs, probably due to weak bonds allowing for repeated elastic deformation. Meanwhile, the a-Se had larger and wider adhesion, which might contribute to $Se^0$ granule assemble and aggregation. In addition, BioSeNPs are usually coated with an layer of organic substances (e.g. EPS), as FTIR and XPS confirmed polysaccharide and amides present, which regulated the biogenic $Se^0$ and prohibited it further crystallization.

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References:

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