The Proposed Role of the Bacteria's Nano/Micro-Environment in Mediating Nanoparticle Transformation

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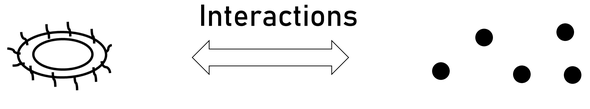
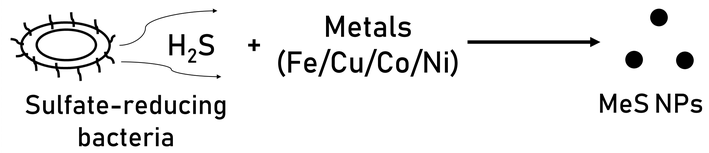
IMPORTANCE



Impacts to:

- Crystal growth – all minerals start from a nano-sized precursor phase
- Properties & reactivity of the resultant mineral
- Fate and behavior of elements in nature

MODEL MICROBIAL-MINERAL SYSTEM

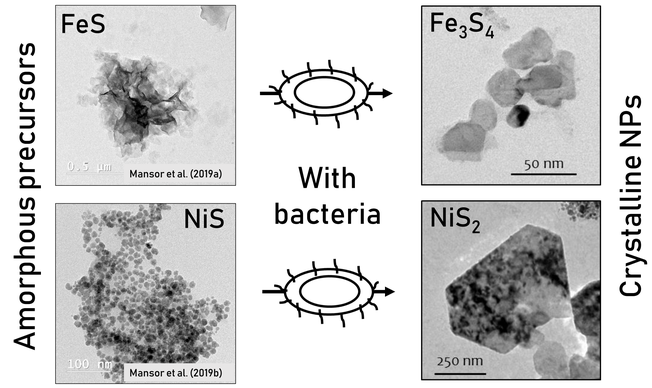


Microbially-mediated precipitation of metal sulfide nanoparticles (MeS NPs)

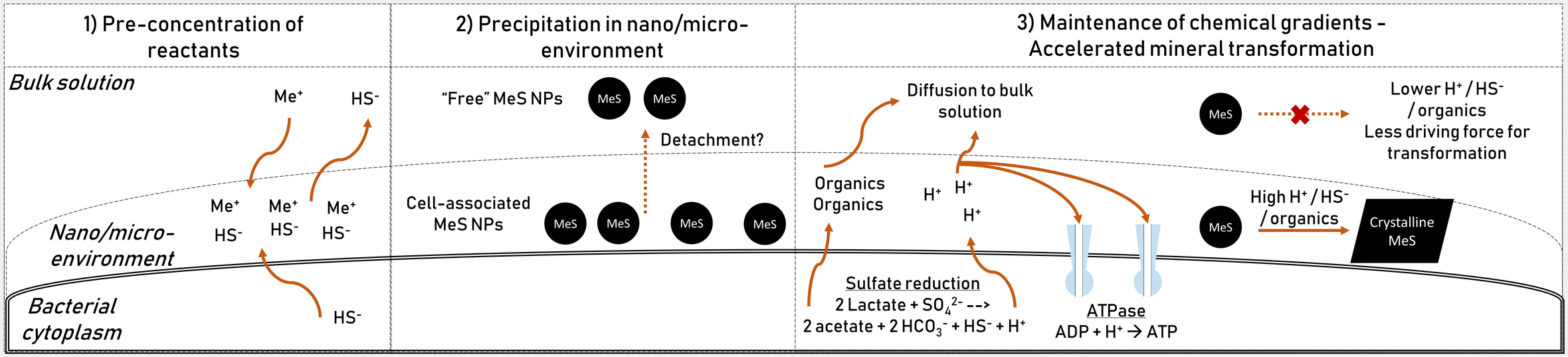
Important in:

- Bioremediation of metal-polluted sites
- Bioavailability of essential trace metals

KEY MICROSCOPY OBSERVATIONS

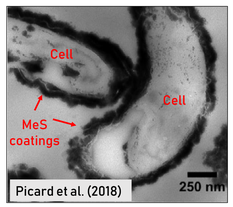


AN UNDERAPPRECIATED ROLE FOR THE CELL NANO/MICRO-ENVIRONMENT IN DRIVING MINERAL TRANSFORMATIONS?



UNRESOLVED QUESTIONS AND THE NECESSITY FOR NEW APPROACHES

1) Extent of difference in "cell-associated" vs "free" MeS NPs
   - Techniques preserving spatial relationships must be improved
   - Mineralogy by TEM/XRD
   - Elemental composition by EDS/spICP-MS



2) Chemistry of the nano/micro-environment
   - *Nano-scale* chemical visualization and reactive transport modeling needed
   - Does the thickness changes as a function of water flow or metabolic rates?
   - How different is the chemistry compared to the bulk solution?

ACKNOWLEDGEMENTS

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Mansor et al. (2019a,b,c) – A series of papers on the precipitation of mixed-metal sulfide nanoparticles at low temperatures

Picard et al. (2018) – Detailed work on the interaction between Fe-sulfides and sulfate-reducing bacteria

Purcell (1977), Beveridge et al. (1976, 1981), Mera et al. (1992) – Pioneers on the importance of the cell microenvironments in various processes