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Siderophores as agents for the bio-based recovery of indium and gallium from low-concentrated waste waters

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Siderophores are iron-chelating compounds that play an integral part in the global iron cycle. They are produced by a vast number of bacteria, fungi and graminaceous plants in order to sequester the essential metal in iron-limited environments. However, they are capable to form coordination complexes with other metals as well, making their potential use in bio-based recycling technologies possible.

The aim of this work is to find siderophores, which selectively bind the energy-critical elements indium and gallium. Due to the vast number of different known siderophores the complete experimental evaluation is impractical, though. Hence, density functional theory (DFT) is used to simulate the chelation reaction in order to estimate the affinities of various siderophores towards gallium and indium as well as the stability of the resulting coordination complexes. Additionally, environmental samples from lagoons of the Atacama Desert are screened for novel siderophore-producing organisms. The siderophores excreted by those organisms might possess unique binding abilities due to the highly saline and alkaline conditions of the isolation sites. Siderophores selected via DFT as well as those produced by isolated microorganisms are tested experimentally for their affinity towards the metals of interest.

Proving the applicability of siderophores in the recovery of indium and gallium from low concentrated waste waters would create a vast amount of further possible applications of the biomolecules to aid securing the future supply of not just said energy-critical elements, but all strategic metals.