

Siderophores assisted Biorecovery of Technology Critical Elements:

Gallium (Ga), germanium (Ge) and indium (In) from end-of-life products

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Abstract:

The development of novel high-tech applications such as communications, renewable energies, displays are heavily dependent on technology critical elements (TCEs) also known as critical raw materials (CRMs) such as germanium, indium and gallium. However, the sustainable supply of CRMs is a major concern and the European Commission has listed the supply of these TCEs as critical among other CRMs.

Recovery of these TCEs from their end-of-life (EoL) products such as electronic waste and low concentrated wastewater produced during device manufacturing is a way to overcome the shortage of these TCEs. However, there are no technologies available for recycling of these metals due to their low recover these metals. Siderophores has been shown to bind selectively to Ga, In and Ge even when these TCEs are present in very low concentrations. Thus, exploiting siderophores for TCEs recovery can be very interesting. However, no work has been carried out to recovery these TCEs from their EoL products using siderophores.

There are many main challenges in the recovery of metals from their EoL products using siderophores. 1) Investigating how the materials may be pre-treated (dismantling, crushing, tinkering with melting temperature) to ensure access of the siderophores; 2) Optimizing the leaching conditions (e.g. S/L ratio, pH, quantity of siderophores); 3) Investigating how TCEs speciation in the targeted EoL materials as well as material structure affect TCEs leaching in presence of siderophores.

This project aims to develop ambitious and highly innovative technology for the recovery of these TCEs. This project will fill the technology gap where no technology exists. This project will help in improving EU competitiveness in resource recovery and recycling. Further, this project supports the circular economy by converting waste to value.

Keywords: Geo and cosmochemistry, geodynamics, critical raw materials, end-of-life products, wastewater, siderophores, biorecovery, recycling