



Subject offered for a contract starting in November 2019

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**SUBJECT TITLE: Application of siderophores in selective leaching of Technology Critical Elements (Gallium (Ga), germanium (Ge) and indium (In)) from end-of-life products**

Advisor: **Eric van Hullebusch (Pr), vanhullebusch@ipgp.fr**

Second Advisor/ Supervisor:

**Benedetti Marc (Pr), Benedetti@ipgp.fr**

Host lab/ Team : *please fill in and leave out meaningless information*

**IPGP- Team Environmental Biogeochemistry – UMR7154**

Financing: ANR funded Doctoral contract

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Presentation of the subject: (1 or 2 pages)

The research project is a European Union ERAMIN2 funded project aiming to implement Siderophores assisted Biorecovery of Technology Critical Elements (TCEs): Gallium (Ga), germanium (Ge) and indium (In) from end-of-life products (SIDEREC).

Among the different project work packages, the project proposes to selectively leach Ga, In and Ge from their end-of-life (EOL) products using siderophores. Leaching of these TCEs from their EOL products is well known (Sethurajan et al., 2019; Isildar et al., 2019). However, selective leaching is important from two aspects: (1) It effectively separates the target TCEs, which are in much lower concentration, from other contamination and (2) the leachates from the siderophores can be an input for already developed Gallophore technology (Jain et al. 2019).

In the frame of this PhD research, selected siderophores will be therefore exploited for selective leaching of Ga, Ge and In from EOL products. This study will target different EOL products such as EOL (fiber optics cable, photovoltaics, LCD panels, and LEDs) as well as wastewater generated during their production.

The PhD candidate will in particular investigate how the materials may be pre-treated (dismantling, crushing, tinkering with melting temperature) to ensure access of the siderophores. The candidate will also optimize the leaching conditions (e.g. S/L ratio, pH, quantity of siderophores). Also, the candidate will investigate how TCEs speciation in the targeted EOL materials as well as material structure affect TCEs leaching in presence of siderophores. Finally, siderophore bound TCEs will be recovered using the "Gallophore" technology (Jain et al., 2019). This latter aspect will be investigated in close collaboration with Helmholtz-Zentrum Dresden-Rossendorf (Germany).

The PhD duration is three years and the research activities will be mostly developed at Institut de Physique du Globe de Paris (Paris, France) (<http://www.ipgp.fr/en>).

## References

Jain, R., Fan, S., Kaden, P., Tsushima, S., Foerstendorf, H., Barthen, R., ... & Pollmann, K. (2019). Recovery of gallium from wafer fabrication industry wastewaters by Desferrioxamine B and E using reversed-phase chromatography approach. *Water Research*, 158, 203-212.

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Sethurajan, M., van Hullebusch, E. D., Fontana, D., Akcil, A., Deveci, H., Batinic, B., ... & Neto, I. F. (2019). Recent advances on hydrometallurgical recovery of critical and precious elements from end of life electronic wastes-a review. *Critical Reviews in Environmental Science and Technology*, 49(3), 212-275.

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