SIM² Mission

SIM² targets zero-waste, environmental-friendly, cost-effective recovery-/recycling approaches, covering the full value chain.

SIM² Vision

A Society that uses its resources in an efficient, effective and sustainable way.

SIM² Research

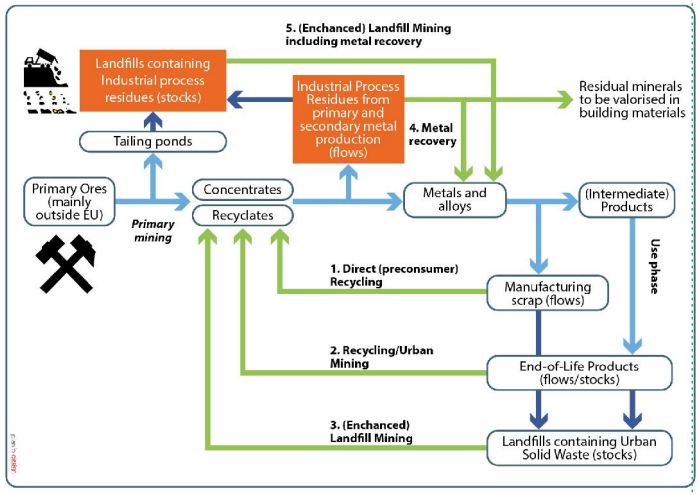
Research in SIM² KU Leuven is performed in four interconnected Research Lines (RLs).

- Base Metal Production and Recovery (led by Prof. Bart Blanpain).
- Critical Metal Recovery (led by Prof. Koen Binnemans) http://rare3.eu/.
- Secondary Resources for Building / Engineered Materials (led by Dr. Yiannis Pontikes).
- Sustainability Assessment and Policy Research (led by Prof. Karel Van Acker).

SIM² KU Leuven targets

1. Direct (preconsumer) recycling.
2. Postconsumer recycling and/or urban mining.
3. Landfill mining of historic urban solid waste.
4. Metal recovery from industrial process residues.
5. Metal recovery from landfilled industrial process residues.

Residual mineral matrixes are valorised in engineered materials. RARE³ represents the Research Line in SIM² KU Leuven focusing on the critical metal recovery.



Research Line 2: Critical Metal Recovery:

Innovative, efficient processes are developed for the recovery of rare-earth elements (REEs) and other critical metals (PGMs, Ge, In, Sb, Ga, Co, Ta) from end-of-life consumer goods, industrial process residues and low-grade ores. A combined use is made of pyro-, hydro-, solvo-, iono-, electro- and metallurgical methods. The recovery of the critical metals is part of larger flow sheets, which target zero-waste valorisation of the metal-containing residues.

Recent research breakthroughs

- Split-anion extraction for innovative separation of rare earths.
- Process for recovery of Eu and Y from End-of-Life fluorescent lamps.
- Selective recovery process of rare earths from NdFeB magnets by sulphation roasting.

Research Line Leader

Prof. Koen Binnemans (Dept. Chemistry) is a world-leading expert in the chemistry of REEs and the environmentally-friendly use ionic liquids ILs in solvent extraction and critical metal recovery. Author of more than 200 papers on REEs (320 papers in total) with a h-index of 48 (54 according to Google Scholar) and over 10000 citations. General coordinator of EU FP7 MC-ITN EREAN and H2020 MSCA-ETN REDMUD and Steering Committee Member of ERECON (DG Enterprise and Industry). Vice-chair of the European Rare-Earth and Actinide Society (ERES).

Flagship topics:

- **Design of extractants and adsorbents for critical metal recovery:** New extractants and adsorbents are designed, synthesised and characterised. Special attention is paid to new ionic liquid extractants and to adsorbents derived from biopolymers (chitosan and alginate). Also traditional extractants are prepared in high purity for fundamental studies.
- **Solvometallurgical leaching and preconcentration of critical metals:** In solvometallurgical processes, the aqueous phase of hydrometallurgical processes is partly or completely replaced by an organic solvent. One approach is "solvent leaching" in which the leaching is performed with a complexing agent (acting as an extractant) in an organic solvent. Lixiviants are often more reactive in organic solvents than in water. A second solvometallurgical method is "slurry solvent extraction". Here, the finely crushed ore is wetted by a small volume of acid solution, and this slurry is contacted with a water-immiscible organic phase, containing an extractant. This approach is similar to conventional solvent extraction, but the volume of the aqueous phase is largely reduced.
- **Solvent extraction for separation and purification of critical metals:** Undiluted ionic liquids are used in solvent extraction processes for the separation of mixtures of rare earths and for the purification of other critical metals. Undiluted ionic liquids offer in solvent extraction the advantage of a very high extractant concentration, allowing for high metal loadings in the organic phase. Because other extraction mechanisms are operational for solvent extraction with ionic liquids than for molecular solvents, more selective extraction processes can be designed with ionic liquids.
- **Critical metal recovery from dilute aqueous waste streams:** Metal ions are recovered from dilute aqueous waste streams and leachates by means of highly selective adsorbents. Two types of adsorbents are being considered: (1) adsorbents made by functionalisation of biopolymers such as chitosan or alginate, and (2) supported ionic liquid phases (SILPs). In SILPS an ionic liquid is immobilised on a solid support. SILP technology is very flexible, because both the type of ionic liquid and the solid support can be optimised independently. By the use of functionalised ionic liquids, very selective adsorbents can be obtained.
- **Alternative energy forms (magnetic, microwave, ultrasound) for process intensification and enhanced metal recovery:** Leaching of metals is accelerated by microwave irradiation or ultrasound, but it is also possible to get more selective leaching by these methods. Separation of paramagnetic from diamagnetic metal ions by strong magnetic fields is an innovative new approach to the separation of mixtures of metal ions.
- **Quantitative characterisation and distribution analysis of critical metals in primary raw materials and residues:** Procedures for the quantitative analysis of platinum-group metals, rare earths and other critical metals in a variety of minerals and residues by field emission gun electron microprobe (FEG-EPMA)

Become a Member of the RARE³ Industrial User Committee (IUC)

RARE³ KU Leuven interacts intensively with industry and society through its "Industrial User Committee". The IUC list includes US, EU and Flemish players in the field of rare earths and other critical metals (In, Ge, Sb, Ta, Co, etc.). The IUC is organised on a 6-monthly basis. Industrial participants get to hear about breakthrough research results at KU Leuven and have the chance to offer valuable feedback and engage in implementation projects.. To join the IUC, a signed Letter of Intent and NDA has to be sent to Prof. Koen Binnemans and Dr. Ir. Peter Tom Jones.

CONTACT

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RARE3 KU Leuven dissemination

Full list of peer-reviewed papers available on:
http://www.kuleuven.rare3.eu/papers/

RARE³/SIM² Events:
http://www.kuleuven.rare3.eu/events/
http://set.kuleuven.be/mrc/sim2/symposiaandevents

RARE³ in the international press:
http://www.kuleuven.rare3.eu/press/

Flagship projects and consortia with SIM³ KU Leuven

SIM³ KU Leuven is a core partner in EIT Raw Materials and the European Enhanced Landfill Mining Consortium

eit RawMaterials

EURELCO
EUROPEAN ENHANCED LANDFILL MINING

KU LEUVEN rare

SIM² KU Leuven Research Line:

CRITICAL METAL RECOVERY

http://www.kuleuven.rare3.eu/