

Joint (internal) Researcher meeting by
SIM² KU Leuven & Materials Research Centre Leuven

**Pushing the boundaries of
advanced materials characterisation**

Heverlee - June 3, 2022 (12-18h)

KU LEUVEN



**KU Leuven Institute for Sustainable Metals and Minerals (SIM²):
Dr. Peter Tom Jones (Director)**

Joint Researcher Meeting by SIM² KU Leuven & MRC – Pushing the
boundaries of advanced materials characterisation – 3 June 2022

SIM² KU Leuven is one of the “KU Leuven Institutes” (official since 2020)

Interdisciplinarity



LKI - LEUVEN CANCER INSTITUTE

The Leuven Cancer Institute brings together doctors, healthcare workers and researchers of University Hospitals Leuven and KU Leuven in their fight against cancer. LKI combines and integrates innovative research, therapy and healthcare to foster interaction between these domains.

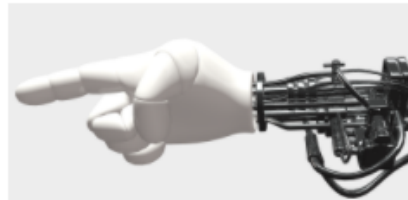
[Read more about the Leuven Cancer Institute >](#)



SIM² - KU LEUVEN INSTITUTE FOR SUSTAINABLE METALS AND MINERALS

The KU Leuven Institute for Sustainable Metals and Minerals wants to contribute to the environmentally friendly production and recycling of metals, minerals and engineered materials. As such, it aims to support the transition to a climate-friendly, circular economy.

[Read more about the KU Leuven Institute for Sustainable Metals and Minerals >](#)



LEUVEN.AI - KU LEUVEN INSTITUTE FOR ARTIFICIAL INTELLIGENCE

The KU Leuven Institute for Artificial Intelligence brings together KU Leuven's worldclass AI experts. It fosters innovative education, research and expertise on all aspects of AI, including the possibilities and limitations of AI and its implications from an ethical, legal and societal perspective.

[Read more about the KU Leuven Institute for Artificial Intelligence >](#)

Breaking news: SIM² becomes KU Leuven Institute for Sustainable Metals and Minerals

After a 16 month evaluation procedure SIM²'s candidacy to become a formal KU Leuven Institute was formally accepted by the KU Leuven authorities.

[READ MORE](#)



Would you like to know more about KU Leuven Institutes in order to prepare your own application? Be sure to take a look at the DOC website.

[SUBMIT YOUR APPLICATION](#)

“

For the University, the Leuven Institutes are a way to highlight certain focal points in research – a strategic instrument, in other words.

- Rector Luc Sels

SIM² KU Leuven – our founding fathers (and mothers)



Strong tradition in bilateral projects & Flemish IWT/VLAIO O&O projects + MIP/SIM ICON/SBO projects with Flemish industry

Structurally funded HiTemp Centre since 2003

Since 2005

2012: Break-through EU Projects



ERC PoC
SOLVOLI

ERC CoG
MICRODISCO


H2020 HARARE
HE ENICON
HE HEPAESTUS
ERA-MIN ACROBAT
ERA-MIN SCANDERE
EOS ECOBAT
HE SIMPLI-DEMO
HE INCREASE
EIT projects...



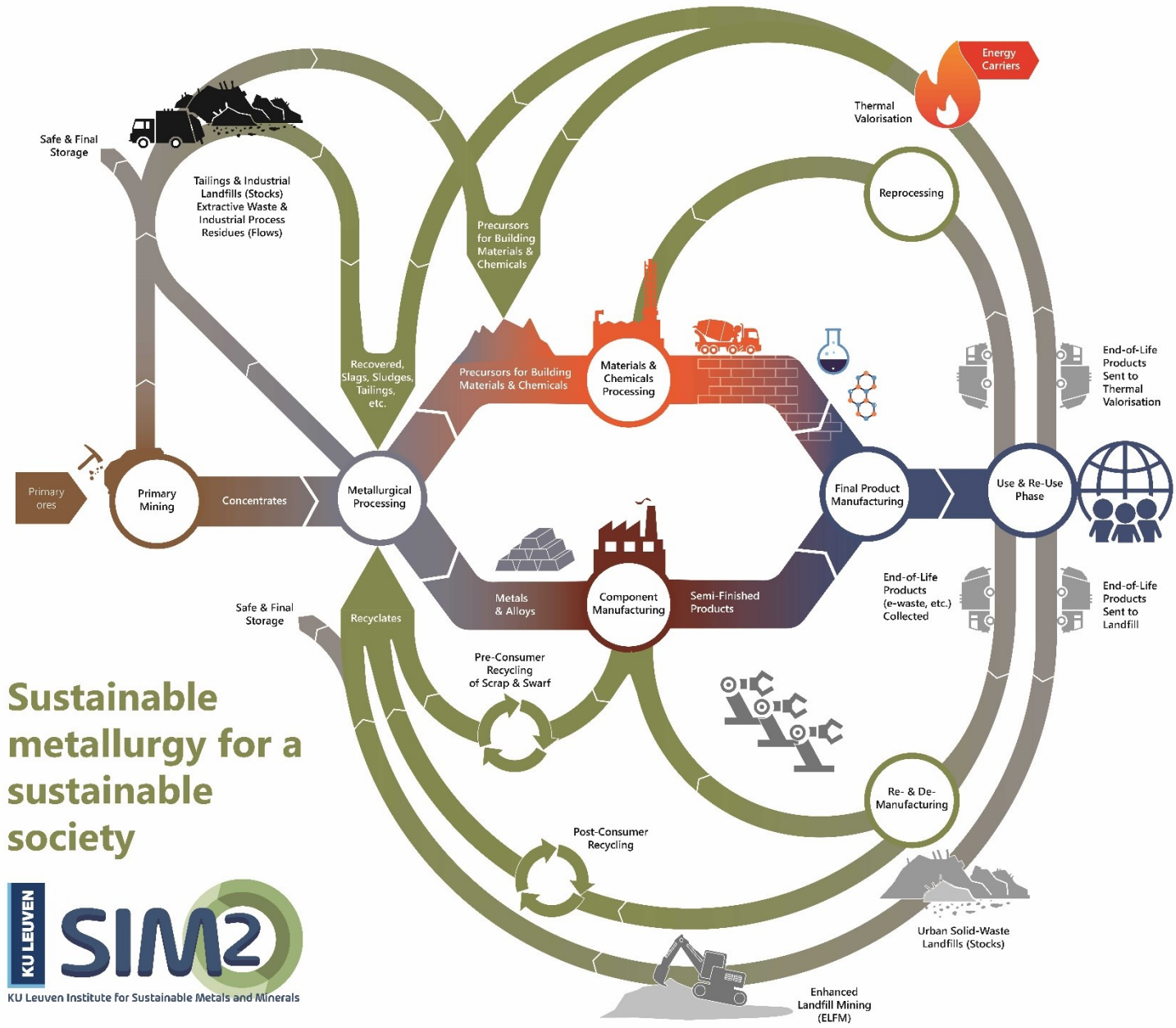
SIM²: A timely mission

SIM² contributes “to environmentally-friendly production & recycling of metals, minerals & engineered materials, supporting the transition to a climate-friendly, circular-economy”

Megatrends [deep de-carbonisation]



renewable energy – energy storage – e-mobility

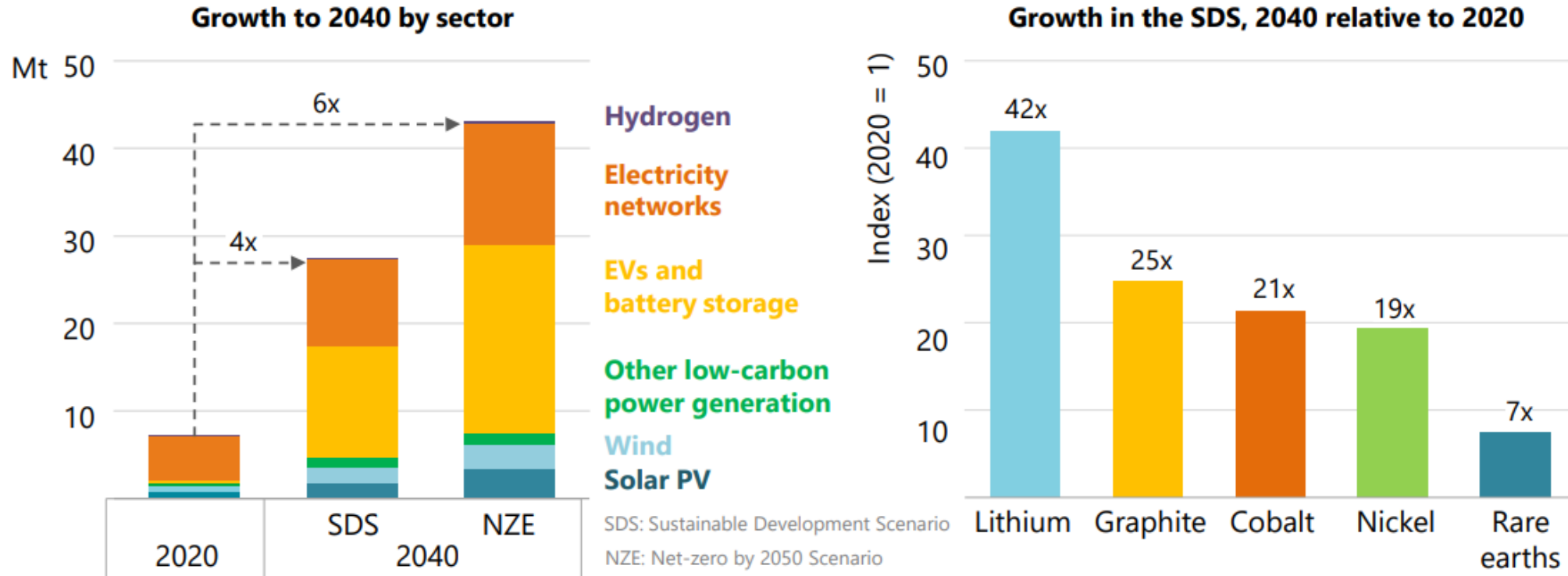


Sustainable metallurgy for a sustainable society



Meeting climate goals will turbo-charge demand for minerals

Mineral demand for clean energy technologies by scenario



Demand for critical minerals is set to soar over the next two decades as the world pursues net zero goals; overall requirements rise by as much as 6 times, but individual minerals, led by lithium, rise even faster

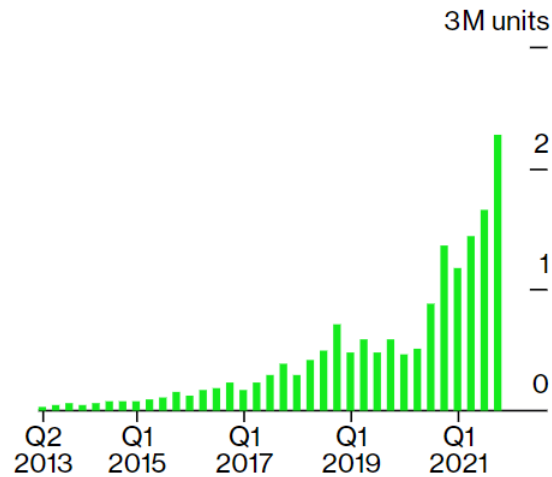
IEA 2021. All rights reserved.

Prices of key minerals & metals for clean energy transition are going through the roof

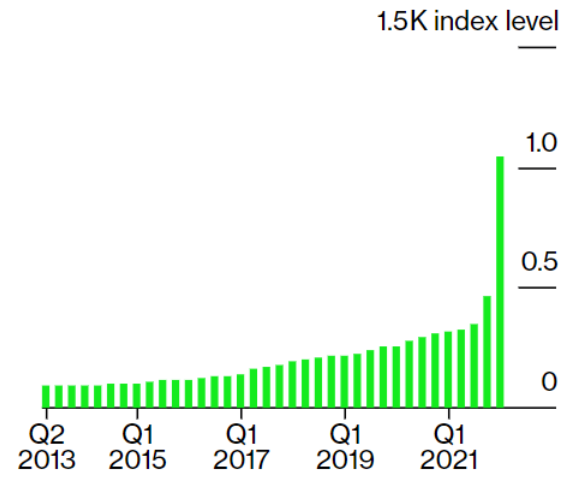
Charging Up

EV battery boom catapults global lithium prices to record levels

Global electric-vehicle sales



Lithium price index



Source: BloombergNEF, MarkLines, Benchmark Mineral Intelligence

- ✓ Combination of **rising demand, disrupted supply chains and concerns around tightening supply**
- ✓ The prices of Ni & Al – for which Russia is a key supplier – have also kept rising, driven in part by Russia's invasion of Ukraine
- ✓ Raw materials now account for a significant and growing share of the total cost of clean energy technologies
- ✓ **Relentless rises in Li prices** are already translating into higher prices for electric vehicles

Timely character of our research – SIM² in the press

THE EUROPEAN GREEN DEAL

SUSTAINABLE METALS FOR A SUSTAINABLE SOCIETY

Climate change and ecosystem breakdown pose an existential threat to Europe and the world. In December 2019, the European Commission launched its European Green Deal, a roadmap to a climate-neutral, resource-efficient and competitive economy.

However, as recently pointed out by the World Bank, the transition towards a climate-neutral economy will be very metal and mineral intensive. For instance, cleantech solutions such as lithium-ion batteries, rare-earth based electric motors and direct-drive wind turbines have a substantial material footprint. Furthermore, even if re-use and recycling rates were increased, there would still be a massive need for (responsible) mining of key primary metals and minerals.

Against this background more than 230 KU Leuven researchers are collaborating in the KU Leuven Institute for Sustainable Metals and Minerals (SIM²). SIM²'s mission is to promote 'problem-driven, science-deep research and future-oriented education, contributing to the environmentally friendly production and recycling of metals, minerals and engineered materials, supporting the transition to a climate-friendly, circular economy.'

SIM² is already developing a number of sustainability programmes, including: new eco-friendly processes to produce raw battery materials such as lithium, cobalt and nickel salts; upcycling of industrial residues, such as non-ferrous slags, into climate-neutral building materials; decarbonising the production of steel and other metals through electrification and novel reducing agents; and sustainability assessment, used to ensure that the environmental impact of newly developed processes are lower with respect to the state of the art.

Likewise, as mining and the recycling of metals and minerals are actions embedded in the real world, SIM² proactively engages with civil society groups and local communities affected by industrial activities so that "no one will be left behind", another directive stipulated in the European Green Deal.



Verloren smartphones, geopolitiek en een koppige Belg

De hindernissen voor de circulaire economie

Om tot een milieuvriendelijkere wereld te komen, moeten we materialen en energie recupereren uit gebruikte toestellen en afval. Maar met die stadsmijnbouw zullen we wellicht nooit helemaal in onze energiebehoefte kunnen voorzien.

Door **DIJK DRILLANS**

Raar maar waar: initiëren om tot een milieuvriendelijkere leefomgeving te komen, staatien soms ook op het proef van milieuvriendelijke. In het Limburgse Houthalen-Helchteren bijvoorbeeld. Daar wil het bedrijf Group Machiels samen met wetenschappers van de KU Leuven de oude bitmo-stroepen ontginnen. Het is de bedoeling om materialen uit het stort te recyclen, waterstof te winnen uit de thermische verwerking van wat overblijft en het terrein vervolgens op te waarderen tot nieuwe natuur.

'Er zijn ongeveer een half miljoen stroepen in België', stelt ingeënter Peter Tom Jones van het Department Materials Engineering van de KU Leuven, een van de promotoren van het project. 'Daar zitten veel verloren materialen die in principe gemakkelijk gerecycleerd kunnen worden, maar een enorme hoeveelheid recupereren energie en landoppervlakte.'

De man is Guat Feyen van de Limburgse Milieudirectie. Hij heeft die procedures tegen het project lopen bij de Raad van State en de Raad voor Vlaamse Milieubezettingen. Feyen stelt dat hij in het algemeen over het concept van stier-plaatsmijnbouw is, maar dat er nog te veel vragen zijn over het nut, de haalbaarheid en de ecologische gevolgen van het project. 'Ik begrijp ook niet waarom ze zo experimenteel per se op een van de grootste stroepen van Vlaanderen willen uitvoeren', zegt hij. 'Ze denken dat het heel ernstig is op kleine schaal. Als er da's iets misloopt, zijn de gevolgen middelgroot.' Feyen lijkt in deze en andere aspecten van het NIMB-concept niet in zijn hart te zitten. 'Ik zie niet in waarom we dat niet gewoon in België proberen. Het is toch een heel eenvoudig probleem. De Europese Commissie houdt een beetje van 'kritische raw materials'.

Sustainable metals for a sustainable society

KU Leuven Institute for Sustainable Metals & Minerals (SIM²)

On November 26, 2019, the KU Leuven Academic Council formally recognised SIM² as one of the first 'KU Leuven Institutes'. SIM², the 'KU Leuven Institute for Sustainable Metals and Minerals', wants to contribute to the environmentally friendly production and recycling of metals, minerals and engineered materials. SIM²'s mission statement is fully in line with the ambitions of the European Commission to become climate neutral by 2050 and to avoid replacing Europe's reliance on fossil fuels with a reliance on non-energy raw materials.

PETER TOM JONES

KU LEUVEN INSTITUTES

In 2018, Rector Leo De Maesseneke launched the KU Leuven Strategic Plan, which included the desire to establish some flagship 'KU Leuven Institutes'. These bodies would foster interdisciplinary research with a crucial societal relevance, focusing on topics that remain important in the long term.

SIM²

For the University, the Leuven Institutes are a way to highlight certain focal points in research – a strategic instrument, in other words. For the outside world, they are a recognizable contact point for a specific area of research. And for the individual researcher, they are a form of recognition, a signal towards organisational security, and a kind of intellectual home base – alongside the faculties and departments. '...'

In 2019, the Academic Council agreed upon a formal and application procedure and opened a formal call. As such, five institutes have come to fruition: IBI KU Leuven Brain Institute, IRI KU Leuven Cancer Institute, Leuven KU Leuven Institute for Artificial Intelligence, LECTO KU Leuven Institute for the Study of the Transmission of Texts, Ideas and Images in Antiquity, the Middle Ages and the Renaissance and SIM², the KU Leuven Institute for Sustainable Metals and Minerals.

METAL AND MINERALS FOR CLIMATE ACTION

In December 2019, prior to the COVID-19 outbreak, the European Commission launched its ambitious European Green Deal, a roadmap towards a climate-neutral, resource-efficient and competitive European economy. Energy, buildings, industry and mobility were highlighted as the four (interrelated) economic sectors that require near-term transitions.

However, as recently pointed out by the World Bank in its *Materials for Climate Action* report, the transition towards a climate-neutral economy will be very metal and mineral intensive. Cleantech solutions such as lithium-ion batteries, rare-earth-based electric motors and direct-drive wind turbines have a substantial material footprint. To meet the EU's green COVID-19 climate targets by 2050, the EU would need, just for electric vehicle batteries and energy storage, almost 60 times more lithium and 15 times more cobalt in 2050, compared to the current supply to the whole EU economy. Similarly, demand for rare earths used in permanent magnets for e-mobility and wind generators would increase tenfold by 2050.

CRITICAL RAW MATERIALS RESILIENCE

As highlighted in the updated EC's Critical Raw Materials list, Europe finds itself in a highly vulnerable position because the supply of key materials such as lithium, cobalt and rare earths is dominated by a limited number of non-EU countries. The supply risk is now compounded by the COVID-19 crisis. Beyond the devastating health impact, COVID-19 is having very substantial impacts on raw material supply chains globally. Raw materials cannot be taken for granted. Europe urgently needs more Critical Raw Materials Resilience (CRMR) to avoid increasing Europe's reliance on fossil fuels with a reliance on non-energy raw materials. Hence, securing a diverse, sustainable and uninterrupted supply of critical raw materials to the EU is a vital, strategic, long-term issue for Europe.

SIMP TO THE RESCUE

The grand societal challenge lies at the heart of the KU Leuven Institute for Sustainable Metals and Minerals on, in brief, SIM². Developing new, efficient and sustainable processes for the extraction, production, recovery, recycling, and refining of metals and minerals, as the core of what SIM² does. With respect to clean energy and mobility, SIM² develops new eco-friendly processes to produce and ultra-refine battery raw materials such as lithium, cobalt and nickel salts, which are essential ingredients for the best-performing lithium-ion batteries.

Likewise, SIM² is a key actor in the upcycling of diverse industrial process residues, such as non-ferrous slags, into (almost) beschikbaar. Er staan 27 chemische elementen op de lijst, zoals koper en kobalt - van dat laatste wordt 65 procent van de wereldproductie in het onstabiele Congo gewonnen.

De 'zeldzame aarden' vormen de bekendste groep kritische materialen. In tegenstelling tot wat hun naam doet vermoeden, zijn de meeste zeldzame aarden helemaal niet zeldzaam. Ze komen overal sterk verspreid in gesteenten voor, waardoor winning niet evident is. Er zijn weinig rijkdommen van zeldzame aarden. Hoewel die verspreid zijn over alle continenten, produceren China en Mexico meer dan 95 procent van de zeldzame aarden. Noodnood is het meest kritische van de zeldzame aarden. Het wordt verwerkt in permanente magneten voor de generatoren van windmolens en de motoren van elektrische voertuigen.

Kritische materialen

De kritische materialen leiden ons tot een tweede paradox. Als we niet willen kappen onder de gevolgen van de globale klimaatopwarming, moeten we dringend af van onze energievoorziening afha-ward op fossiele brandstoffen. Maar daarvoor moet er ook een transitie van de materialenproductie komen: nieuwe technologieën hebben nieuwe schakelende nodig.

In de tijd dringt. Als geen ander weet klimaatwetenschapper Serge de Guchtère, een van het consultancybedrijf Future-proof, te schetsen wat er mogelijk is. Het staat als we niet snel de omvang maken naar energievoorziening op basis van hernieuwbare bronnen, zoals zonn en wind. De globale opwarming zal op dag een hoeveelheid hitte in de atmosfeer die overreikt met die van 400.000

Europe faces critical shortage of metals needed for clean energy

Supply challenges come as EU seeks to reduce its dependence on Russian imports

Commodities + Add to myFT

A mine worker takes water samples from a brine pool at a lithium mine in Chile. The report estimates that to meet its clean energy goals, Europe will require 35 times more lithium in 2050 compared with today © Cristóbal Olivares/Bloomberg

Peter Tom Jones
Director KU Leuven Institute for Sustainable Metals and Minerals at KU Leuven
1w • 9

"Metals for Clean Energy: Pathways to solving Europe's raw materials challenge", that's the title of the new [Eurometaux \(European Metals Association\)](#) report written by my SIM² KU Leuven colleagues Liesbet Grégoir and Karel ...see more

Eurometaux - Metals for Clean Energy • 117 pages

KU LEUVEN

Metals for Clean Energy: Pathways to solving Europe's raw materials challenge

1 / 117

Lieven Machiels and 97 others
9 comments • 3 shares

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SIM²: the pinnacle of interdisciplinarity

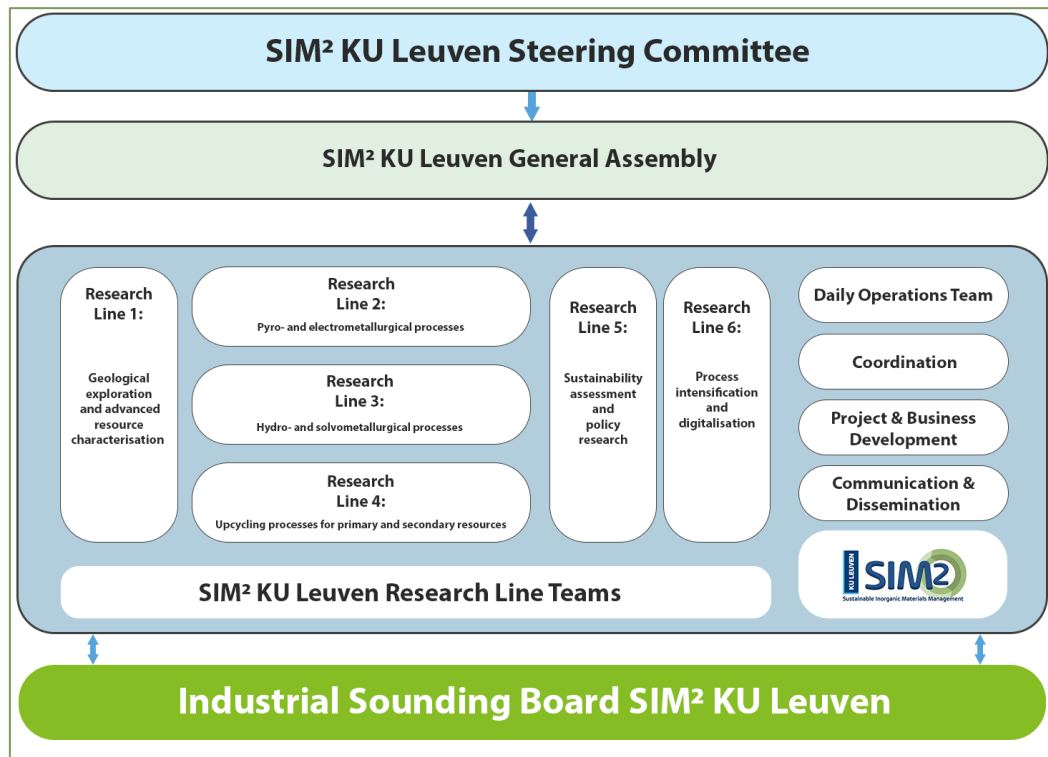
243 SIM² Members

16 Research Groups from Chemical Engineering, Materials Eng', Mechanical Eng', Civil Eng', Architectural Eng', Chemistry, Earth and Environmental Sciences, Economy and Management, Law

11

49
in
GA

243
Members



General Assembly Members

- Luc Alaerts
- Karen Allacker
- Marion Bechtold
- Koen Binnemans
- Bart Blanpain
- Patrick Degryse
- Simon De Jaeger
- Andrea Di Maria
- Elisabeth De Decker (DOT)
- Giorgian Dinu (DOT)
- Valérie Cappuyns
- Özlem Cizer
- Marc Craps
- Johan De Greef
- Wim Dehaen
- Wim Dewulf
- Joost Duflou
- Jan Elsen
- Johan Eyckmans
- Jan Fransaer
- Jean Paul Gueneau de Mussy
- Muxing Guo
- Shuigen Huang
- Niels Hulbosch
- Katarzyna Janusz (Edu)
- Peter Tom Jones (Dir/DOT)
- Lubica Kriskova
- Simon Kuhn
- Jiabin Li
- Lieven Machiels
- Annelies Malfliet
- Philippe Muchez
- Olivier Namur
- Rabab Nasser (DOT)
- Lucian Onisei (DOT)
- Martina Orefice
- Jef Peeters
- Yiannis Pontikes
- Frederik Rademakers
- Sofia Riaño
- Dimitrios Sakellariou
- Rudy Swennen
- Erik Smolders
- Karel Van Acker
- Geert Van Calster
- Jo Van Caneghem
- Tom Van Gerven
- Piet Wostyn (DOT)
- Xing Yang

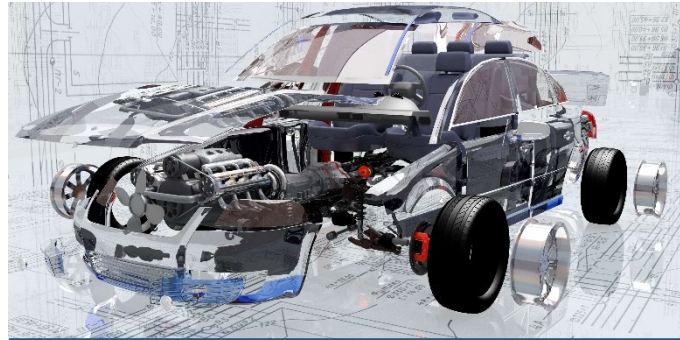


GA Meeting SIM², Novotel Leuven, February 2020 (Pre-Corona)

SIM²: 6 Research Lines



RL1. Geological exploration and advanced resource characterisation



RL2. Remanufacturing and demanufacturing



RL3. Sustainable metallurgical processes



RL4. Upcycling processes for primary and secondary resources



RL5. Sustainability assessment and policy research



RL6. Process intensification and digitalisation

Developing interdisciplinary projects is key to what we do – Horizon Europe

✓ Projects granted:

1. HE ENICON
2. HE SIMPLI-DEMO
3. ERA-MIN SCANDERE
4. ERA-MIN ACROBAT
5. HE RECLAIM
6. HE INCREASE

✓ Projects on the Reserve List: HE e-LiTE, HE PERICLE

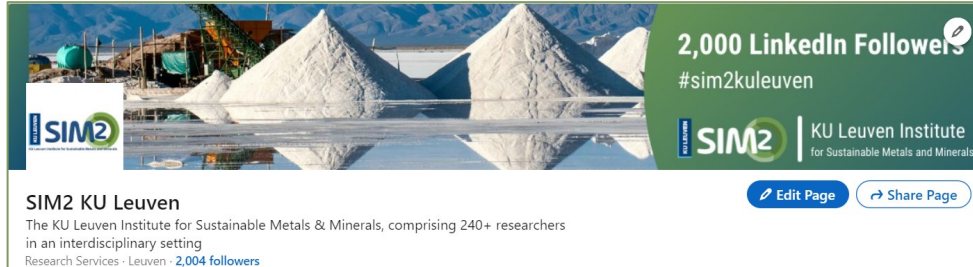
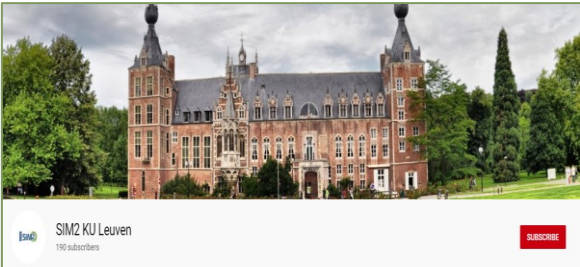
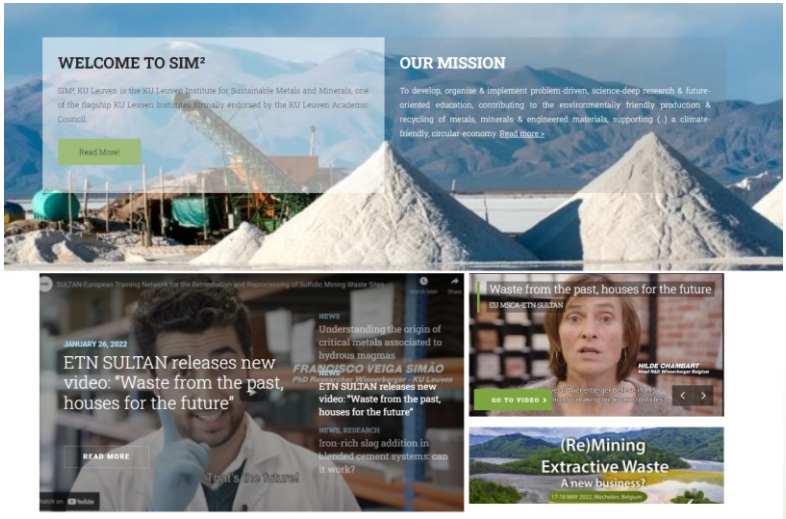
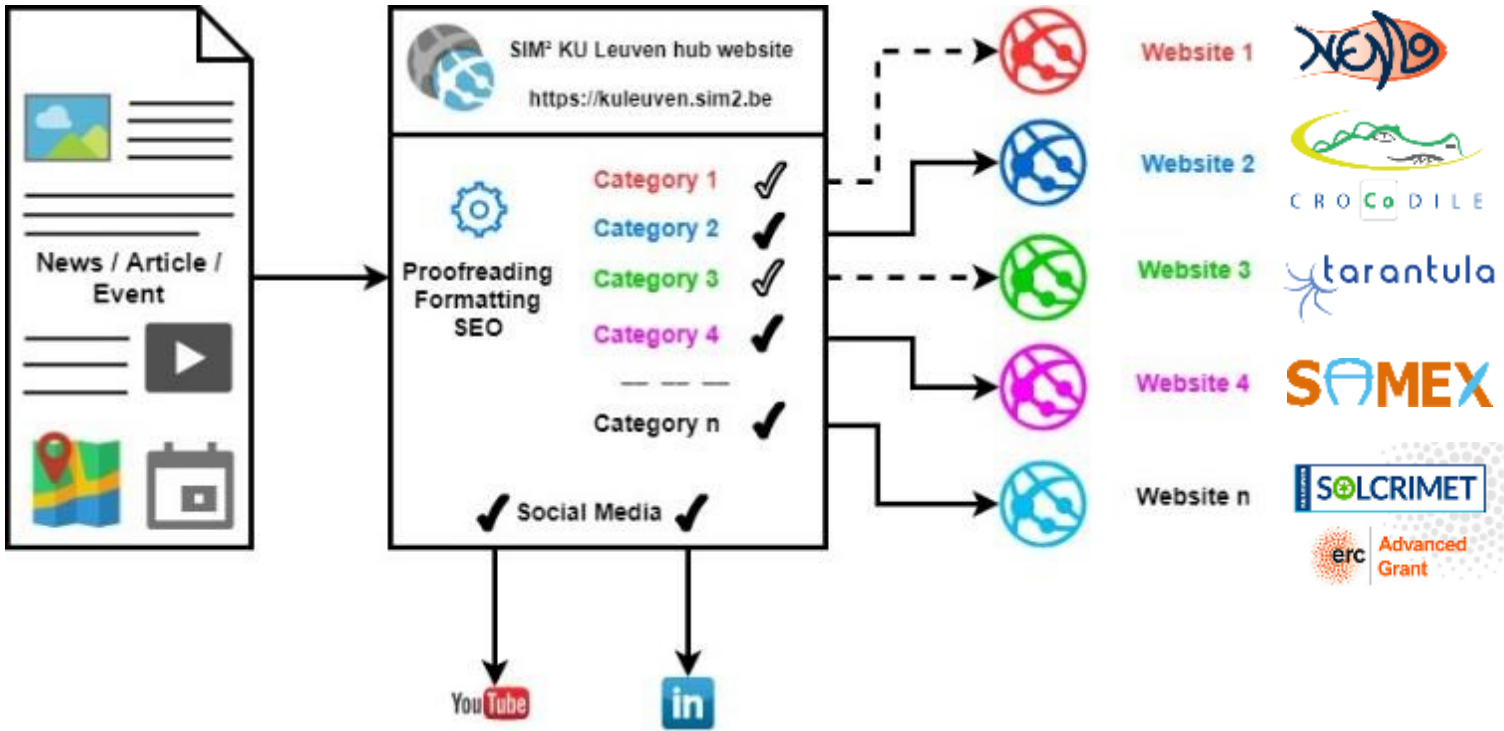
✓ Projects in evaluation: HE EXCEED, HE ERC ADG CIRMET, HE FIREFLY



SIM² organises International Symposia E.g. Remining Symposium May 2022



Dissemination and visibility: SIM² mother hub website



SIM² communication: boosting our papers/interviews & LinkedIn corporate page

2,000 !



Become a follower!



SIM2 KU Leuven

The KU Leuven Institute for Sustainable Metals & Minerals, comprising 240+ researchers in an interdisciplinary setting
Research Services · Leuven · [2,004 followers](#)



Understanding the origin of critical metals associated to hydrous magmas

colleagues



"Mining of critical metals has to bring economic and social benefits to Africa"

colleagues



Providing fingerprints of molecules and materials using high-resolution Magnetic Resonance

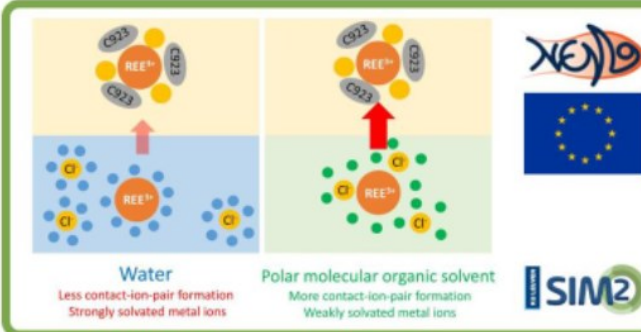
colleagues



SIM² disseminates your research

SIM2 KU Leuven
1,971 followers
1w •

Separation of a mixture of **#rareearthelements** is notoriously difficult. Hence, research that targets higher efficiency in such processes is very relevant. One possible avenue is to adopt non-aqueous solvent extraction rather than ...see more



The diagram illustrates two extraction methods for rare earth elements (REE³⁺). On the left, in a water-based system, REE³⁺ ions are surrounded by water molecules, forming a strongly solvated metal ion. This results in less contact-ion-pair formation. On the right, in a polar molecular organic solvent, REE³⁺ ions are coordinated by organic ligands (represented by green and red spheres), forming weakly solvated metal ions. This results in more contact-ion-pair formation. The diagram also includes logos for XEROX, the European Union, and SIM2.

Unravelling the chemistry within non-aqueous solvent extraction
kuleuven.sim2.be • 3 min read
You and 17 others 2 shares

SIM2 KU Leuven
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Antimony is one of the **#criticalrawmaterials** for Europe, given its high supply risk. Strategies to recover Sb from Sb-bearing secondary resources are, therefore, of great importance. **SIM2 KU Leuven** – HiTemp researchers studied the ...see more




The figure shows the characterisation of Sb-containing metallurgical residues. It includes an EDX spectrum, a scanning electron microscope (SEM) image, and a color-coded elemental map. Below the images is a flowchart of the recovery process: Anodic removal → Lead recovery → Cathodic reduction → Antimony recovery → Anodic deposition.

Characterisation of Sb-containing metallurgical residues for Sb recovery
kuleuven.sim2.be • 3 min read
You and 31 others

SIM2 KU Leuven
1,971 followers
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How can we boost the **#repair** & **#recycling** options for end-of-(first)-life **#electronicdevices** such as washing machines? How can we use **#ai** and **#iot** to support this endeavour? ...see more



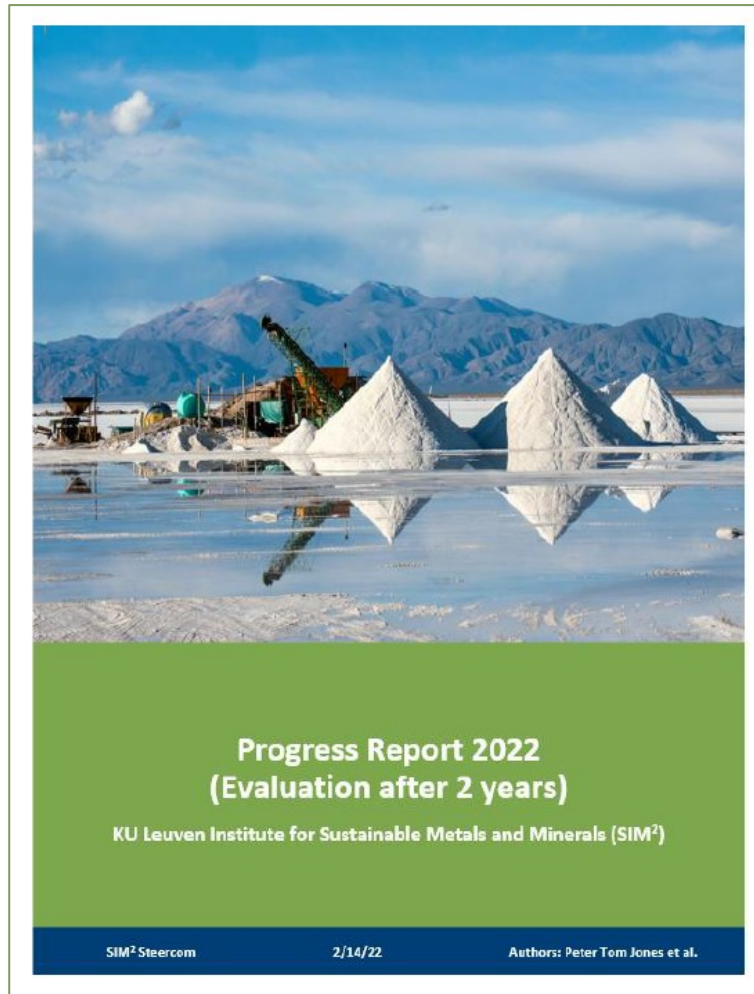
The video thumbnail features a man speaking and the logo for 'VLAANDEREN CIRCULAIR'. The text on the video reads: 'In the OVAM Flanders Circular project SmartRe, we therefore, together with our partners, ...see more'. The video player interface shows a play button, a progress bar at 0:26, and various control icons.

Boosting the repair & recycling options for EoL electrical consumer products
kuleuven.sim2.be • 3 min read
You and 16 others 3 shares



Send us a post about your paper/project – we will edit it, publish it on the SIM² website and boost it on LinkedIn

SIM²'s evaluation (2022) & self-assessment



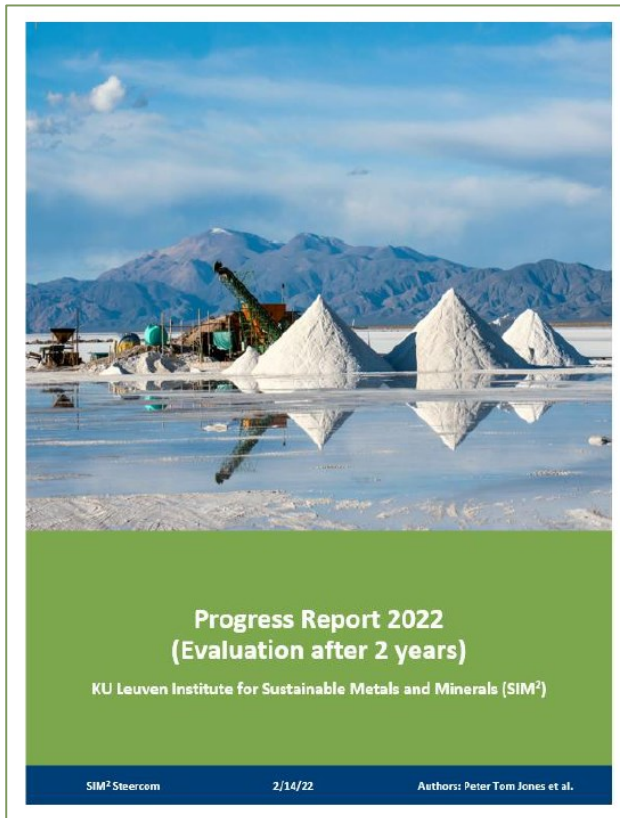
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From the evaluation report (Ad Hoc Panel):

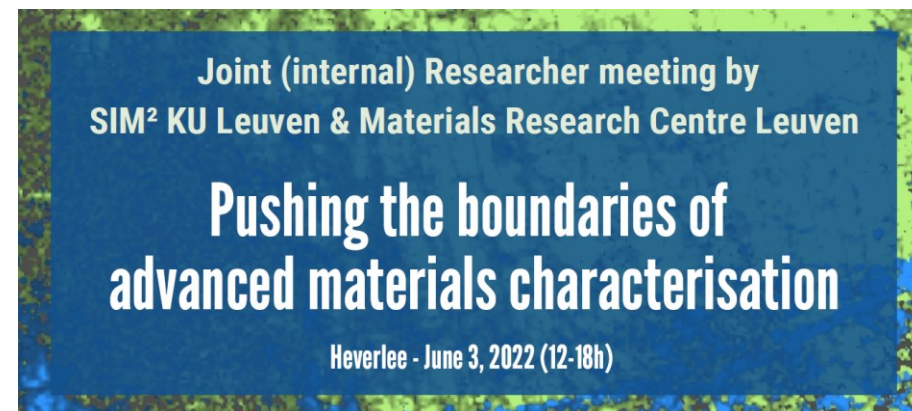
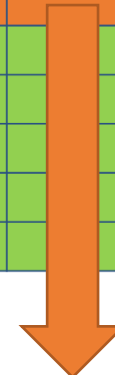
Dit instituut heeft de teugels stevig in handen en heeft een duidelijke visie waar men naartoe wil evolueren. **SIM² is dan ook een mooi voorbeeld van hoe het kan en moet.** Het consortium stond al van in het begin sterk in de steigers, en toch hebben zij in de voorbije jaren niet stil gestaan en hebben zich verder doorontwikkeld qua schaal, differentiatie en breedte. (...)

De tussentijdse evaluatie wordt dus als zeer positief beoordeeld.

SIM²'s evaluation (20220224) & self-assessment



Goal	Poor	Acceptable	Good	Very good	Excellent	Criterion #
Obtaining additional research funding						#1, #3, #5
Integration of new PI's						#1, #4, #8
New interdisciplinary collaborations						#1, #5
Engagement of PhD students linked to SIM ² PI's						#1
Setting up new initiatives						#1, #5, #8
Pulling power towards international researchers						#1, #7
Brand recognition/being the benchmark						#1, #7
International dissemination & social media						#1, #6
Visibility in press & societal impact						#1, #9



<https://kuleuven.sim2.be/>

Contact: [Peter Tom Jones \(LinkedIn profile\)](#)



Programme today

12-13.15h Lunch & poster Session

13.15-13.45h Introductions by **Dr. Marion Bechtold (MRC)** & **Dr. Peter Tom Jones (SIM²)**

13.45-15h Guest Lecture **Dr. Gilles Mertens (Qmineral)** (*XRD, the most important mineral characterisation tool*)

KU Leuven contributions by **Dr. Annelies Malfliet (EPMA-WDS)**, **Fernando Prado Araujo** (*Shine on you crazy materials: Raman microscopy for advanced characterisation*)

15-15.30h Coffee & Poster session

15.30-17h KU Leuven contributions by **Prof. Erik Smolders (LA-ICP-MS)**, **Prof. David Seveno (Liquids and gases as probes to characterise surface properties)**, **Prof. Claudia Fleischmann (Atom probe tomography: materials characterisation at the nanometer-scale)**, **Prof. André Vantomme (Ion beam analysis: a family of versatile techniques for materials characterisation)**

17-18h Closing reception & poster Session