SUPERMET PROJECT

PRESS RELEASE – June 2021

Recycling precious metals using a sustainable process

Recycling precious metals using a sustainable process is the aim of the R&D SUPERMET project launched in 2018. Three years-after, the SUPERMET project shows promising results to develop a new technique for the recycling of Palladium (Pd) coming from spent catalysts. Three papers have been published in scientific journal (Materials, Journal of CO_2 Utilization and Molecules). SUPERMET project will end on October 2021 and the final results will be presented during the Pollutec Fair (Lyon 2021).

Precious metals, in particular palladium (Pd), have a wide range of daily applications, from automotive catalysts to fine chemistry production. Nevertheless, these metals are relatively rare and highly expensive, considering their massive industrial utilization. In the last decades, different recycling methods have been explored. Nowadays, the most applied methods, namely pyro- and/or hydrometallurgy, involve energy-intensive processes and/or the generation of large amounts of effluents to be treated.

The innovation of SUPERMET project is to use a green process to perform this recycling: the supercritical CO_2 process. This technique normally cannot be used to extract metal and therefore the idea of SUPERMET project is to design and test copolymers as extracting additives to remove the precious metals from the spent catalysts in supercritical CO_2. The originality of the project is also to work on real catalysts.
The precious metals (Pd, Pt, Rh) are present in very small quantities inside the support of the catalyst (0.5 to 2 wt%) and their quality varies according to the type of the supported catalysts. Therefore, the first technical challenge of the scientific consortium coordinated by ICGM (ICGM, Heraeus, Fraunhofer ICT, INOE-ICIA, IFS) was to select and analyze a range of virgin and spent supported catalysts containing palladium, platinum and rhodium metals. The second challenge was to design and synthetize copolymers able both to be soluble in supercritical CO_2 media and to complex the precious metals from the supported catalysts.
During the life of SUPERMET Project, almost 20 types of catalysts have been characterized, 64 copolymers have been designed and 212 supercritical CO_2 extractions have been performed. During this research work, the analytical method used to asses the content of Pd and Pt in catalysts has been optimized. Different copolymers have been identified for their capacity to be soluble in supercritical CO_2 and to extract the precious metals. The experimental conditions that have been set for the extraction are mild ones (40°C, 250 bar). The best results show an extraction efficiency of more than 70 % of palladium (Pd) from an alumino-silica-supported catalyst using the SUPERMET copolymers.

Final steps now in SUPERMET project are to scale-up the process from 2 g to about tens grams of supported catalyst, to improve the final recovery of the precious metal and to make the techno and economical evaluation of this new process as well as its life cycle assessment.

The knowledge and know-how created during the project such as the use of advanced analytical methods for precious metal characterization, the synthesis of new copolymers complexing metals and the measurement of their solubility (cloud points) in supercritical CO_2 could be useful for other projects such as critical metal recycling from lithium-ion batteries or fuel cell devices.

Along the three years and despite COVID-19 crisis, the results of the SUPERMET project have been communicated to a dozen of scientific events (workshops, European or international congresses) covering different scientific areas: analyses, green processes, polymers, supercritical fluids. In final communication steps, the SUPERMET project has been presented as a KeyNote Lecture in May 2021 during the "18th European Meeting on Supercritical Fluids, online event"; during the Pollutec Fair which will be held in Lyon (12–15 October 2021), I.F.S and ICGM will have a booth there in the Auvergne Rhone-Alpes Area. It will be a great opportunity to promote the SUPERMET project towards industrial and public communities.

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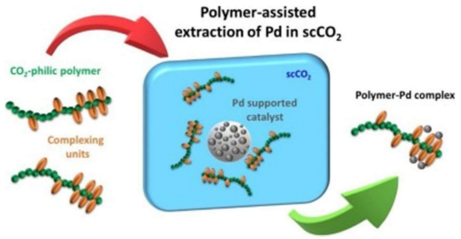
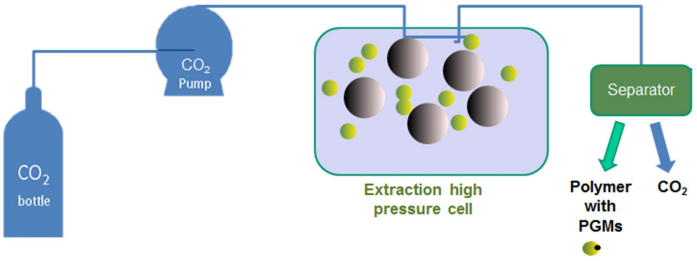
References of the scientific articles on SUPERMET Project:

- ✓ Ruiu, A.; Bauer-Siebenlist, B.; Senila, M.; Li, W.S.J.; Seaudeau-Pirouley, K.; Lacroix-Desmazes, P.; Jänisch, T. Supercritical CO_2 Extraction of Palladium Oxide from an Aluminosilicate-Supported Catalyst Enhanced by a Combination of Complexing Polymers and Piperidine. *Molecules* **2021**, *26*, 684. https://doi.org/10.3390/molecules26030684
- ✓ Senila, M.; Cadar, O.; Senila, L.; Böringer, S.; Seaudeau-Pirouley, K.; Ruiu, A.; Lacroix-Desmazes, P. Performance Parameters of Inductively Coupled Plasma Optical Emission Spectrometry and Graphite Furnace Atomic Absorption Spectrometry Techniques for Pd and Pt Determination in Automotive Catalysts. *Materials* **2020**, *13*, 5136. https://doi.org/10.3390/ma13225136
- ✓ Ruiu A., Bauer-Siebenlist B., Senila M., Jänisch T., Foix D., Seaudeau-Pirouley K., Lacroix-Desmazes P., Promising polymer-assisted extraction of palladium from supported catalysts in supercritical carbon dioxide, *Journal of CO_2 Utilization* **2020**, *41*, 101232. https://doi.org/10.1016/j.jcou.2020.101232



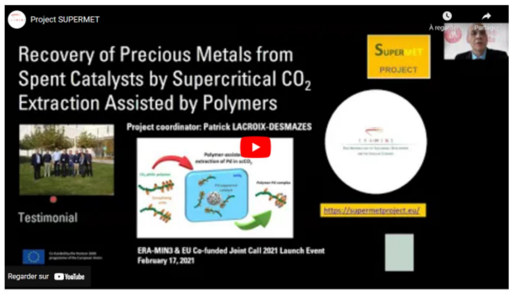
SUPERMET Project challenge © ICGM



SUPERMET Project process with Supercritical CO_2

About SUPERMET project:

- ✓ It has been laureate of ERA-MIN 2 call for proposal, co-funded by the Horizon 2020 Program of European Union.
- ✓ It aims to explore new and green techniques to recycle precious metals from spent catalysts.
- ✓ Total budget : 1.5 Millions €



Video on SUPERMET Project

More information: contact@supermetproject.eu - www.supermetproject.eu

https://youtu.be/_FgS5RS_UC0

Financial Supports :

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