

PRECIOUS METAL EXTRACTION, SEPARATION, RECOVERY.

THE Pd CASE: FROM FUNDAMENTAL TO APPLIED RESEARCH

R. Mastretta, V. Lacanau, D. Bourgeois, D. Meyer - C. Contino-Pépin, F. Bonneté, P. Wagner, M. Schmitt, F. Bihel

Palladium is a precious metal which is principally employed in autocatalysts. The increasing demand in palladium for this application combined with stable production has recently led to a sharp rise in palladium price as the market remains tight. Palladium price more than doubled over the last three years, and even, in January 2019, reached that of gold. Since then, palladium price regularly reaches record height, higher than 100 k€/kg (3000 \$/oz) in early March 2022. Palladium market is expected to go further in deficit and production from other secondary resources becomes a key to fulfil palladium needs. Supply from the so-called urban mine appears as a very attractive alternative to traditional mining, especially for Western countries, poorly endowed with natural mineral ores.

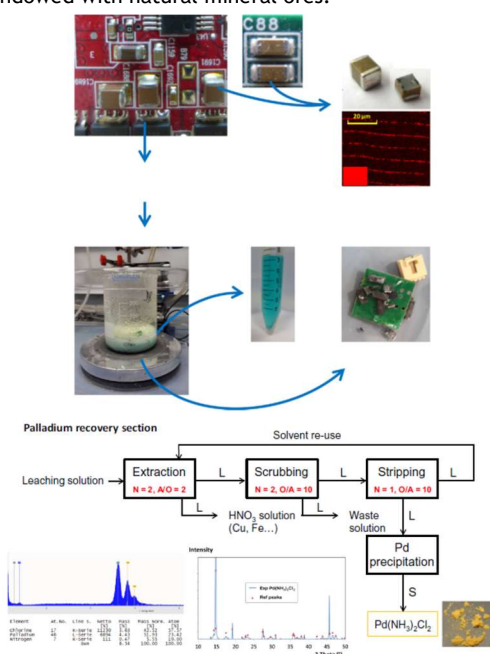


Figure 1: Pd recovery from PCB and related process diagram

In this context and based on more fundamental studies already published, the LHys team has developed different hydrometallurgical approaches to recovering Pd from various wastes.^{1,2} We were able to lay the foundations for various process diagrams (Fig. 1).³

In collaboration with groups from University of Avignon and University of Strasbourg, we recently proposed to bridge the gap between growing needs for precious metals and difficulties to value e-waste, through the use of precious metal based catalysts directly prepared from e waste (Fig. 2).⁴

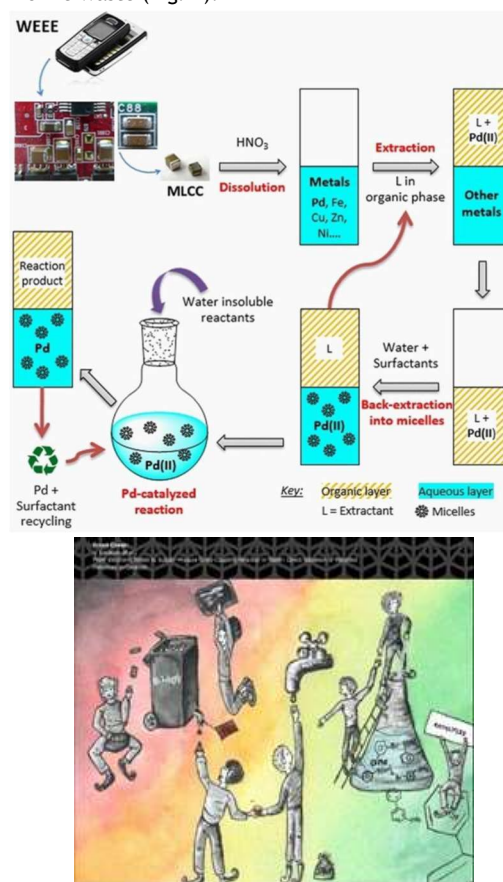


Figure 2: Direct use in micellar catalysis of Pd recovered from printed circuit board

This strategy is currently developed at the LHYS, through investigation of the technical challenges associated with the approach in the field of fine chemicals synthesis, on selected applications in homogeneous and heterogeneous catalysis.

¹ R. Mastretta, R. Poirot, D. Bourgeois, and D. Meyer "Palladium Isolation and Purification from Nitrate Media: Efficient Process Based on Malonamides", *Solvent Extraction and Ion Exchange*, 2019, 37, 2, 140–156.

² D. Bourgeois, V. Lacanau, R. Mastretta, C. Contino-Pépin and D. Meyer "A simple process for the recovery of palladium from wastes of printed circuit", *Hydrometallurgy*, 2020, 191, 105241.

³ D. Bourgeois, D. Meyer, PCT Int. Appl. 2018, WO2019048789A1, 07/09/2017; D. Bourgeois, D. Meyer, B. Braibant, PCT Int. Appl. 2018, WO2019048790A1, 07/09/2017; S.A. Moussaoui, A. Lélías, B. Braibant, D. Meyer, D. Bourgeois "Solvent extraction of palladium(II) using diamides: A performing molecular system established through a detailed study of extraction kinetics", *Sep. Purif. Technol.*, 2021, 119293.

⁴ V. Lacanau, F. Bonneté, P. Wagner, M. Schmitt, D. Meyer, F. Bihel, C. Contino-Pépin and D. Bourgeois "Palladium Isolation and Purification from Nitrate Media: Efficient Process Based on Malonamides", *ChemSusChem*, 2020, 13, 5224–5230.