SELECTIVE SORPTION OF PALLADIUM

on an innovative functional polymer containing phosphine oxide

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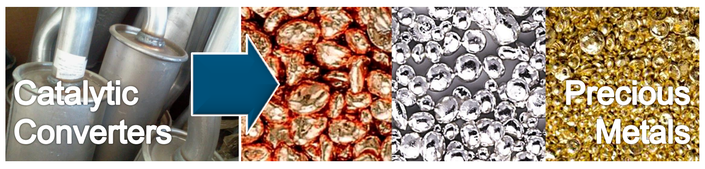
Introduction

- After the leaching of ores or waste catalytic converters, **Platinum Group Metals (PGM)** are often found in trace amounts in effluents amidst common metals. Their selective extraction and concentration is then a major issue for refiners.



- A new functional material containing **aminophosphine oxide groups** *(Figure 1)*, chemical groups traditionnally used in coordination chemistry of transition metals, is studied as selective sorbent of palladium.
- Sorption mechanisms and sorption properties of the polymer are investigated.

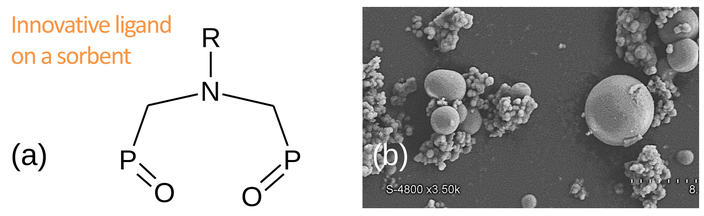
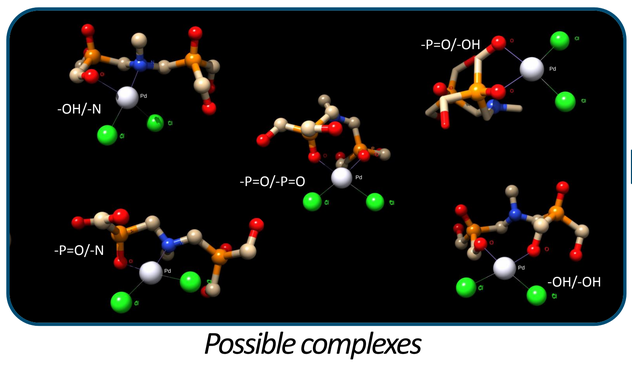


Figure 1. Polymer powder containing phosphine oxide, (a) Functional group, (b) appearence.

Determination of mechanisms and sorption properties

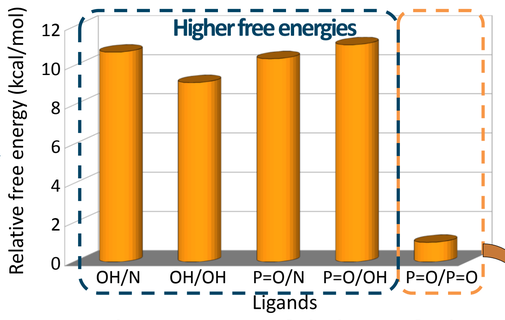
Sorption mechanisms

Determination of sorption sites by molecular modeling



Possible complexes

DFT

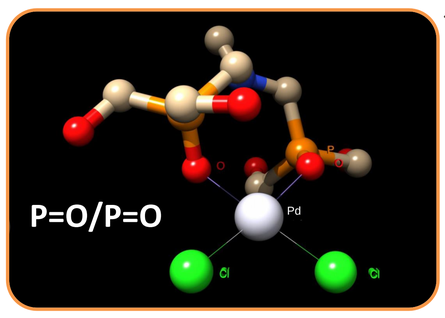


Relative energy of chelates of Pd

Lower free energy

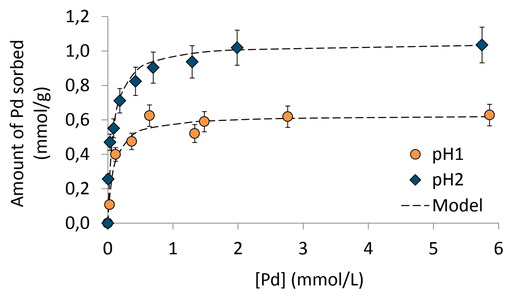
Model structures of possible chelation modes calculated by **DFT** (b3lyp/6-31++g** and b3lyp/lanl2dz for Pt or Pd).

The most stable species is the bis P=O ligated complex



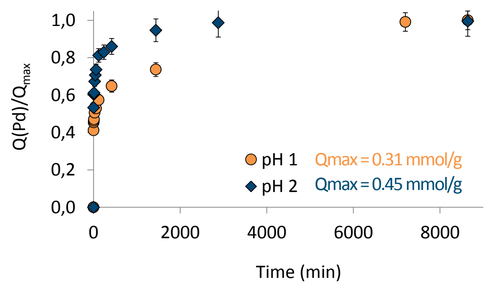
Sorption properties in batch reactor

[HCl] influence on sorption isotherms and kinetics



Sorption isotherms fitted by the Langmuir model.

Sorption isotherms
(V = 50 ml, m = 0.03g, 25 °C)



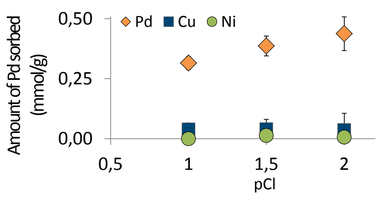
Fast kinetics due to the large surface area of the micrometric powder.

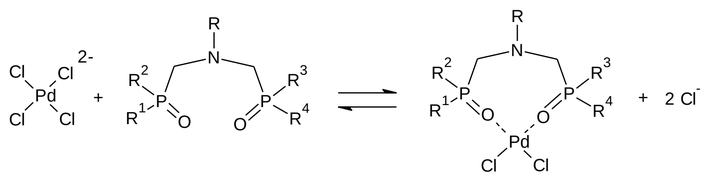
Sorption kinetics
(V = 250 ml, m = 0.150 g, 25 °C)

Confirmation of sorption mechanisms by experiments

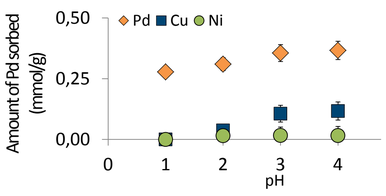
Sorption mechanisms were proposed based on the influence of solution parameters to support the DFT results.

Influence of chloride concentration

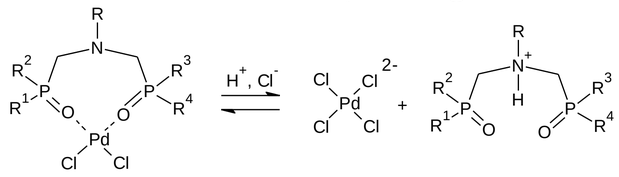




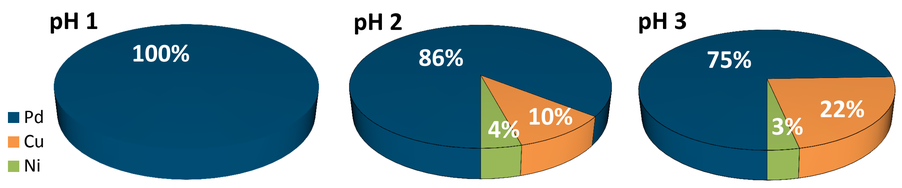
Influence of pH



Equilibria involving [H⁺] and [Cl⁻] without proton release confirm the chelation by P=O ligands.



Sorption selectivity and recovery



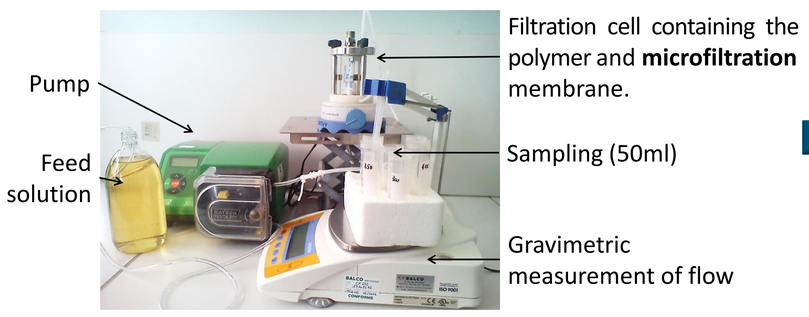
pH effect on the selectivity of the sorption from a solution with [Pd] = [Cu] = [Ni] = 0.3 mmol/L..

Sorption selectivity of palladium from a solution containing common metals is improved at **low pH**.

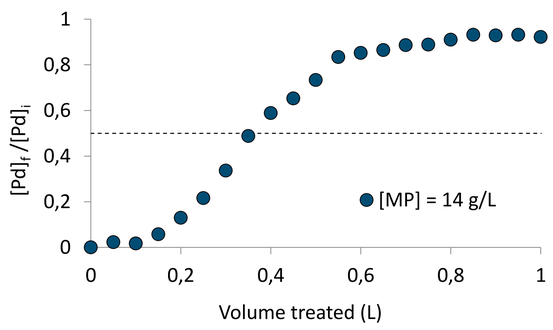
Palladium was recovered over 90 % by elution with a thiourea solution (0.1 M, pH2).

Preliminary results in continuous process

The selective recovery of **Pd traces** from effluents containing large concentration of common metals in **continuous flow** is studied with a **sorption-filtration** setup.



Continuous flow filtration setup



Variation of the outlet palladium concentration

Conclusion

Selective sorption and concentration of palladium are achieved by the **palladium coordination to phosphine oxide groups**.

The **high selectivity** in strong acids, as well as the **fast kinetics** and **facile metal recovery** by elution, makes this material an attractive candidate for industrial applications.