PRECIOUS METALS RECOVERY FROM WEEE AND SPENT CATALYTIC CONVERTERS

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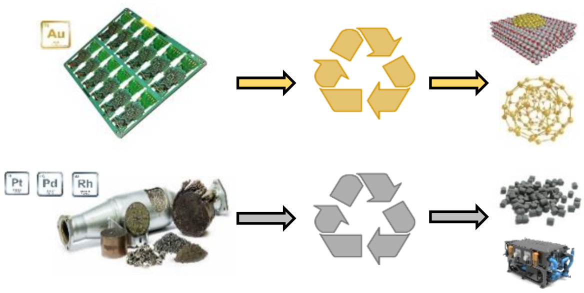
The circular economy of noble metals is a critical point of development for the European Union. Great efforts are focused on the development of technologies to produce secondary raw metals from waste. This process is made complex by the presence of several metals in our commodities and by the use of hazardous chemicals (strong acids, cyanides, etc.) and high temperatures in the conventional recovery processes which increase safety risks and environmental impacts, and has severe repercussions on the legal authorization process. My PhD work, supported by COGEI, a company with a huge expertise in water treatment whose goals coincide with the ones related to this research in terms of process sustainability, aims to push forward the development of green and sustainable hydro-solvometallurgical processes for the recovery of selected noble metals: gold (Au), platinum (Pt), palladium (Pd) and rhodium (Rh). The first three among these are selected because of their abundance in large-scale commodities (e.g., in printed circuit boards of waste electric and electronic equipment, WEEE, and spent automotive catalysts, WCat) and their high economic value (30-40 €/g). Besides, WCats contain large amounts of Rh (300-500 €/g), another critical raw material whose recovery is crucial to sustaining the process profitability due to its high price of purchasing. The new selective hydro-solvometallurgical methods are meant to boost the sustainability and the circular economy of the noble metal recovery processes in several ways. The methods will involve the adoption of leaching solutions and operating conditions for the selective and high-efficiency recovery of the noble metals aimed at substantially lower the environmental and safety hazards compared with conventional leaching. The subsequent refining of leaching liquors will be carried out by adsorption on conventional (carbonaceous materials, metal semiconductors) and innovative (functionalized electrospun fibers, ESF, and engineering biowastes, EBW) sorbents, aimed to enhance the yield and the selectivity of the recovery process and possibly allow recycle of the spent leaching liquor. The adsorption will be tuned to optimize the metal loading for two separate metal recovery strategies. The first option is the production of secondary raw materials for industrial use through the thermal recovery of the noble metals in the ashes of controlled gasification and pyrolysis processes. The second option exploits adsorption to create metal-loaded sorbents which can be used in catalysis (i.e., thermal and photo-reforming), or to produce fuel cells electrodes, by carefully selecting the sorbent and tuning the operating conditions. Literature findings indicate that Pt and Au catalysts having characteristics remarkably close to the Pt and Au loaded sorbent achievable with the new hydro/solvometallurgical processes can be proficiently used to increase the productivity of biorefining, providing new routes for the valorization of glycerol, an important byproduct of biodiesel production.



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