Hydrometallurgical recovery of gold from WEEE through selective leaching and adsorption with electrospun fibers

Antonio Di Colandrea [a], Luigi Piero Di Bonito [a] , Paraskevas Kyriacou[b], Theodora Krasia-Christoforou[b] & Francesco Di Natale [a]

[a] Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale

Università degli Studi di Napoli "Federico II", Piazzale Tecchio, 80, 80125 Napoli, Italia.

[b] Department of Mechanical and Manufacturing Engineering,

University of Cyprus, Aglantzia, 2109, P.O. Box 20537, Nicosia, Cyprus.

E-mail: antonio.dicolandrea@unina.it

Gold is a critical material in the electronics industry due to its high electrical conductivity and corrosion resistance and exploits valuable catalytic properties. The increasing concerns over the environmental impacts of traditional mining is promoting a shift toward urban mining, particularly the recovery of secondary gold from waste electrical and electronic equipment (WEEE), with waste printed circuit boards (WPCB) being a major source. Among various approaches, hydrometallurgical techniques are gaining ground, typically involving metal leaching in acidic aqueous solutions followed by refining through solvent extraction, precipitation, or adsorption. This study, conducted within the Next Generation EU – MUR PRIN project "Green and Sustainable Urban Mining of Noble Metals," focuses on the sustainable recovery of gold and other critical raw metals from WPCB for potential reuse in waste-derived catalysts for the biofuels industry. This work presents results on a gold recovery process from RAM module based on the sequence of mild leaching solutions and novel electrospun fiber adsorbents. The leaching system, based on HCl/H_2O_2 solutions, was designed to be more environmentally sustainable while maintaining efficiency comparable to conventional methods. Leaching experiments were carried out at 40 °C in stirred batch reactors, achieving over 99% gold recovery. The resulting leachates were cooled and treated with new electrospun membranes composed of PEO and PMMA blends functionalized with 2-cyano-2-propylbenzodithioate for enhanced selectivity toward gold ions. The membranes demonstrated excellent stability in the leaching solutions and adsorb more than 100 mg/g even at low gold concentrations (<20 mg/L). Unexpectedly, the presence of copper in solution improved the overall adsorption efficiency while preserving strong selectivity for gold. These results underline the potential of combining mild leaching and functionalized electrospun fibers as an effective and sustainable strategy for recovering gold from WEEE, offering a viable alternative to conventional mining and hydrometallurgical methods.

Keywords: *Gold, Recovery, Leaching, Adsorption, Electrospinning.*