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Ionometallurgy for Recycling Silver in Silicon Solar Panel

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Abstract : This work is in the CABRISS project (H2020 projects) which aims at developing innovative cost-effective methods for the extraction of materials from the different sources of PV waste: Si based panels, thin film panels or Si water diluted slurries. Aluminum, silicon, indium, and silver will especially be extracted from these wastes in order to constitute materials feedstock which can be used later in a closed-loop process. The extraction of metals from silicon solar cells is often an energy-intensive process. It requires either smelting or leaching at elevated temperature, or the use of large quantities of strong acids or bases that require energy to produce. The energy input equates to a significant cost and an associated CO2 footprint, both of which it would be desirable to reduce. Thus there is a need to develop more energy-efficient and environmentally-compatible processes. Thus, 'ionometallurgy' could offer a new set of environmentally-benign process for metallurgy. This work demonstrates that ionic liquids provide one such method since they can be used to dissolve and recover silver. The overall process associates leaching, recovery and the possibility to re-use the solution in closed-loop process. This study aims to evaluate and compare different ionic liquids to leach and recover silver. An electrochemical analysis is first implemented to define the best system for the Ag dissolution. Effects of temperature, concentration and oxidizing agent are evaluated by this approach. Further, a comparative study between conventional approach (nitric acid, thiourea) and the ionic liquids (Cu and Al) focused on the leaching efficiency is conducted. A specific attention has been paid to the selection of the Ionic Liquids. Electrolytes composed of chelating anions are used to facilitate the lixiviation (Cl, Br, I,), avoid problems dealing with solubility issues of metallic species and of classical additional ligands. This approach reduces the cost of the process and facilitates the re-use of the leaching medium. To define the most suitable ionic liquids, electrochemical experiments have been carried out to evaluate the oxidation potential of silver include in the crystalline solar cells. Then, chemical dissolution of metals for crystalline solar cells have been performed for the most promising ionic liquids. After the chemical dissolution, electrodeposition has been performed to recover silver under a metallic form.

Keywords : electrodeposition, ionometallurgy, leaching, recycling, silver
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