Extraction of Gold from Electronic Waste and Ores

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Overview

A method for selective extraction of gold has been developed at the Weizmann Institute. This method allows the efficient and environmentally benign recovery of gold that is currently discarded of in large quantities from electronic waste from household appliances, consumer electronic devices and industrial equipment.

Prof. Igor Lubomirskyâ€™s novel process is based on volatilization for selective extraction of gold using benign metal salts, rather than dangerous chlorine gas as a chlorinating agent or hazardous and polluting acid mixtures. The new process requires low temperatures and is free from hazardous waste, among its additional advantages over conventional methods.

We believe that this efficient technology is key to increased reclaimed gold, potentially resulting in the reduction of the demand for primary gold.

The Need

Gold is playing an important role in many industrial applications such as jewelry and ornaments, electronics, telephone circuits, dental alloys, etc. In household appliances, consumer electronics devices and other electronic equipment, small amounts of gold are contained in large volumes of materials, typically metal coats and polymers, such as in printed circuit boards (PCB).

Current methods for gold recycling from spent equipment include hydrometallurgical extraction (using aqua regia or cyanide) that results in enormous quantities of hazardous waste and pyrometallurgical techniques that are not efficient as standalone processes, and typically done within metal smelters. An additional method is volatilization recovery of gold done using toxic chlorine gas.

A safe method for gold recovery with low environmental impact, high selectivity and efficiency in mild conditions is thus extremely attractive. The optimal method would be easily industrialized in different scales and result in high yield of the recovered gold.

The Solution

Prof. Igor Lubomirsky and his group developed a novel method for the recovery of gold from spent household appliances, consumer electronic devices and industrial equipment, as well as from gold ores and sands.

The method comprises of crushing the spent material (such as PCB) to obtain a fine particulate material predetermined grain size and reacting it with chlorine containing salts rather than pure chlorine gas in a furnace at low temperatures (under 300oC). This is followed by cooling the volatile gold chloride product and converting it into solid phase metal.

Advantages

- No toxic input â€“ chlorides are used rather than chlorine gas
- No hazardous waste is generated in the process
- Mild conditions. High-temperature furnaces and equipment are not required
- Relatively simple setup in comparison to conventional ones
- Small scale plants are economically viable

Development Status

- The laboratory scale setup is operative, successful experiments have been performed with high yield on gold ores and sands, and further experiments on PCBs are in process. Currently optimized conditions for different types of PCBs are being pursued.
- The next step after optimization is achieved would be to plan a pilot plant.

Market Opportunity

According to the Gold Council 2018, recycled gold is an important part of the market, accounting for around 30% of total supply over the past 20 years. Industrial recycled gold makes up 10% of the total recycled gold, up from less than 5% 10 years ago. It consists primarily of gold found in waste electrical and electronic equipment (WEEE), such as computers, tablets and mobile phones. The global gold supply recycled from electronics reached above $7 billion in 2018. The United Nations Environment Program estimates that only 15-20 percent of WEEE is recycled; the rest goes straight into landfills and incinerators. Whatâ€™s more, the lure of the urban mine has driven growth in the unregulated recovery of metals from WEEE. Chemical leaching involving cyanide and aqua regia is sometimes used without proper safeguards, particularly in the developing world. In untrained hands, this is a polluting and inefficient way to recover metals, and it offers no protection from the dangerous chemicals in these source materials.

Patent Status

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