Sustainable technique recovers gold from e-waste cheaply

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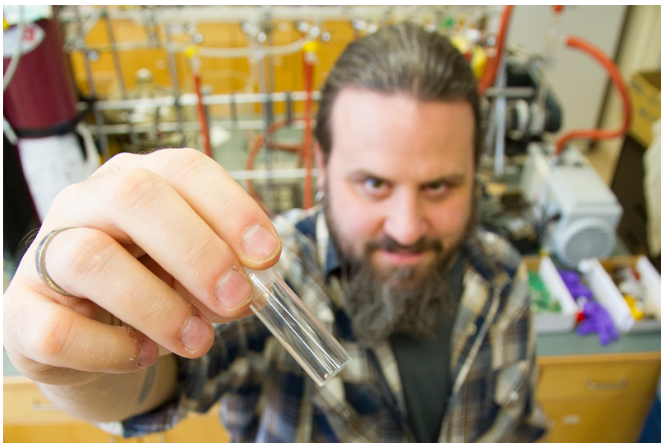

Stephen Foley

Stephen Foley is looking to get his hands on some gold… the problem is that it takes too much time, costs too much money and harms the environment.

The work of his research team—made up of Loghman Moradi, research associate, and Hiwa Salimi, PhD student— changes all of that.

"We've found a simple, cheap and environmentally benign solution that extracts gold in seconds, and can be recycled and reused," said Foley, an associate professor in the Department of Chemistry. "This could change the gold industry."

The problem with gold, explained Foley, is that it is one of the least reactive chemical elements, making it difficult to dissolve. That is why "artifacts discovered from 3,000 year ago still have gold on them."

Given this difficulty, there are two main ways to get gold: through mining gold from the earth, which requires massive amounts of sodium cyanide; and recycling gold from secondary sources like jewelry or electronic scraps.

"The problem with mining has to do with the harsh environmental effects of the toxicity of cyanide that fills tailing ponds," said Foley. "When one of the ponds breaks, it dumps the cyanide into nearby lakes or rivers and kills the environment."

Recycling gold from jewelry or electronic scraps—think computer chips and circuits lined with thin layers of gold—is not without issue either.

Annually, Foley explained, the world produces more than 50 million tons of electronic waste per year; that amount is increasing rapidly due to non-stop innovation that shortens the life span of electronic devices.

Because of the lack of suitable recycling methods, he continued, more than 80 per cent of "e-waste" ends up in landfills, making it a pretty serious environmental issue.

There are two current industry standards for removing gold from electronic scraps. The first is pyrometallurgy, which burns the gold off using high temperatures. This method is energy intensive, cost prohibitive and releases dangerous gases, like dioxins.

The second is hydrometallurgy in which leaching chemicals like cyanide solution or aqua regia—Latin for king's water, which is a mixture of concentrated nitric acid and hydrochloric acid—are used, a process Foley called "expensive, very toxic and completely non-recyclable.

"The environmental effects of current practices can be devastating," said Foley.

Foley used the city of Guiyu, China, considered the e-waste capital of the world, as an example. Guiyu receives 100,000 tonnes of e-waste per day, and because of unregulated processing, Guiyu has the highest levels of dioxins for any city ever recorded. The result, he continued, is the majority of Guiyu's residents have some form of neurological damage.

What Foley and his research team discovered is a process that extracts gold efficiently and effectively without any of the downfalls of current industry practices.

"We use one of the most mass-produced chemicals: acetic acid; at five per cent concentration it's plain table vinegar. We use a minute amount of an acid and an oxidant to finish our solution."

The solution, he continued, is the greenest solvent next to water, so eliminates the vast number of environmental concerns that come with long standing methods of gold extraction.

In this technique, the gold extraction is done under very mild conditions while the solution dissolves gold with the fastest rate ever recorded. "Gold is stripped out from circuits in about 10 seconds leaving the other metals intact" Foley said.

When time is factored in with lower toxicity and consequential effects, this new solution appears to be a natural replacement that could revolutionize the industry.

To highlight the improvement Foley's solution presents, consider that it costs $1,520 to extract one kilogram of gold using aqua regia and results in 5,000 litres of waste. With the U of S solution it costs $66 to produce one kilogram of gold and results in 100 litres of waste that can be reused over again.

The other main advantage over current recycling processes, he continued, is that this specific solution is gold selective, meaning it only dissolves gold not other base metals, like copper, nickel, iron and cobalt, found in printed circuit boards.

"Aqua regia, for example, dissolves everything," he explained, meaning that once dissolved, the gold still needs to be extracted from the solution and the other metals, and the solution gets saturated very quickly.

The next step for Foley and his team is to move the process into large-scale applications for gold recycling from gold-bearing materials.

By large-scale, Foley means very large.

"To extract three grams of gold from ore, you need one tonne of rock. We are not yet viable on a big scale like that," he said, adding that to that end they are currently searching for industry partners.

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