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Technologies to extract, purify critical rare earth metals could be a 'game changer'

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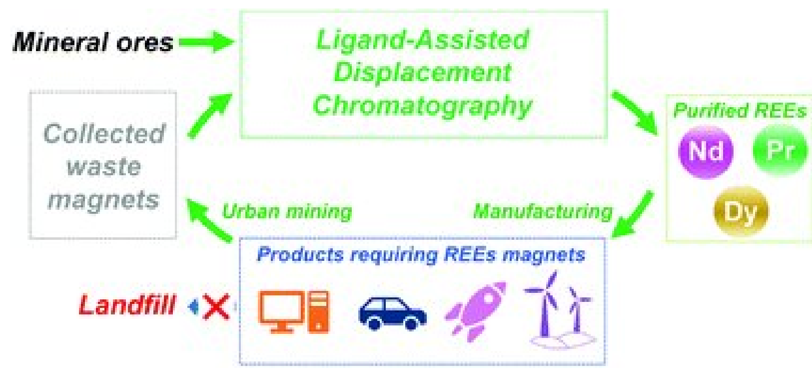

Credit: *Green Chemistry* (2020). DOI: 10.1039/D0GC00495B

The technology – developed and patented from the laboratory of Nien-Hwa Linda Wang, Purdue's Maxine Spencer Nichols Professor of Chemical Engineering – has successfully shown to separate the rare earth metals without the devastating environmental effects of conventional acid based methods with high yield and purity.

One part of this technology was published March 31 in the Royal Society of Chemistry publication *Green Chemistry*.

"About 60% of rare earth metals are used in magnets that are needed in almost everyone's daily lives. These metals are used in electronics, airplanes, hybrid cars and even windmills," Wang said. "We currently have one dominant foreign source for these metals and if the supply were to be limited for any reason, it would be devastating to people's lives. It's not that the resource isn't available in the U.S., but that we need a better, cleaner way to process these rare earth metals."

According to Wang, after China reduced the export quotas for rare earth metals in 2010, the costs of rare earth magnets for one wind turbine increased from $80,000 to $500,000. After China relaxed the export restrictions 18 months later, the prices returned to lower levels than in 2010.

"Conventional methods for producing high-purity rare earth elements employ two-phase liquid–liquid extraction methods, which require thousands of mixer-settler units in series or in parallel and generate large amounts of toxic waste," Wang said. "We use a two-zone ligand-assisted displacement chromatography system with a new zone-splitting method that is producing high-purity (>99%) metals with high yields (>99%)."

Wang's ligand assisted method has the potential for efficient and environmentally friendly purification of the rare earth metals from all sources of recyclates, such as waste magnets and ore-based sources and helps transform rare earth processing to a circular, sustainable process.

"We continue to work diligently in the lab to learn how to adapt the ligand-assisted system to many variations we see in source material and are excited to collaborate with and assess the suitability of potential partners source material be it recycled magnets and batteries, coal ash or domestically mined ore.

Joe Pekny, a Purdue professor of chemical engineering said Wang's innovation enables the U.S. to reenter the rare earth metals market in a significant way and sustainable way.

"What's exciting is that the U.S. has the rare earth metals to meet the growing demands of the U.S. market and other markets around the globe and reduces our dependence on foreign sources," Pekny said. "Linda's method replaces a very inefficient process and replaces it with an earth-friendly, safe extraction process."

More information: Yi Ding et al. Two-zone ligand-assisted displacement chromatography for producing high-purity praseodymium, neodymium, and dysprosium with high yield and high productivity from crude mixtures derived from waste magnets, *Green Chemistry* (2020). DOI: 10.1039/D0GC00495B

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