

Recycling and secondary sources of the rare earth elements

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The rare earth elements (REE) are vital to modern technologies and society and are among the most critical of elements. Despite this, typically only around 1% of the REE are recycled from end-products, with the rest deporting to waste and being removed from the materials cycle. There is significant potential to increase the amount of the REE recycled from major end-uses, such as permanent magnets, fluorescent lamps, batteries, and catalysts, however, a significant amount of research is needed in all of these areas to increase REE recycling rates. The barriers to effective recycling include the fact that end products contain small amounts of the REE, a lack of economic incentives, and the difficulties in extracting the REE from the complex alloys or mixtures of metals that are used in these end products. Increasing the REE recycling rate may enable the overcoming of a number of criticality issues with these elements, including increased demand, security of supply, and overcoming the balance problem where primary mine-derived sources overproduce the lower demand light-REE (e.g. La-Ce) without necessarily meeting demands for the targeted high-demand REE (e.g. Nd-Dy-Tb).

It is important to also acknowledge that recycling is one among many possible responses to perceived REE supply risks. The potential for REE extraction from secondary sources such as low-grade REE industrial residues (e.g. phosphogypsum, slags, bauxite residue (red mud), marine sediments, mine tailings, metallurgical slags, coal ash, incinerator ash and waste water streams) is also significant. Equally, research into other methods of recycling should be promoted; for example, bioleaching has a much lower environmental footprint compared to other REE recycling methods. This presentation provides an overview of the current and future potential of meeting REE demands from recycling and secondary sources, including outlining the significant potential for increased amounts of REE recycling from common end-uses and secondary sources that are currently considered waste.