center for technology transfer and innovation
at the Jožef Stefan Institute

Jožef Stefan Institute, Ljubljana, Slovenia

Environmentally friendly and energy efficient method for recovery of rare-earth elements

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The Jožef Stefan Institute has developed an innovative method for recovery of rare-earth elements from magnet scraps. The method is cost-effective, energy-efficient and environmentally friendly. Partners are sought amongst the companies that recycle magnets and producers of rare-earth oxides and alloys for technical cooperation agreements and license agreements to scale up and apply the technology in their production.

Rare-earth elements (REEs) have excellent electronic, optic, catalytic, and magnetic properties, making them useful for a wide range of applications, such as catalysts, phosphors and pigments, batteries, permanent magnets, and ceramics. The global REE consumption was estimated at 119,650 metric tons in the form of rare-earth oxides (REOs) in 2016 with catalysts being the largest segment, followed by permanent magnets. Diverse methodologies for recycling Nd–Fe–B permanent magnets are currently under development which can be broadly classified into direct re-use, alloy reprocessing and raw material recovery. In conventional hydrometallurgical processes large amounts of acid, alkali and other precipitation agents are used which cannot be recycled in the whole process and consequently a considerable amount of wastewater is produced.

The Jožef Stefan Institute has developed a novel method for recovery of the REEs from Nd–Fe–B magnet scraps, which allows the selective leaching and recovery of the REEs with high efficiency and in a more environmentally friendly and cost-effective way.

Advantages

- REEs can be selectively leached and recovered from Nd–Fe–B magnet scraps with high efficiency (more than 90%) and minimum production costs
- The method does not require any roasting pre-treatment and can be performed at room temperature.
- Recovery of the pure metallic iron (Fe) deposited on the cathode

The method includes anodic oxidation of the magnet scraps and precipitation of rare-earth salts – shown in Figure 1. Currently the research group can produce a few dozens grams of rare-earth salts using this procedure (Figure 2). In order to apply the procedure on an industrial level, the method needs to be scaled up. For the scale up, large baths for anodic oxidation, and engineering knowledge are needed.

The technology has been developed at the Department for Nanostructured Materials, Jožef Stefan Institute whose researchers have several decades of experience in magnetic and other inorganic materials, nanotechnology. The Jožef Stefan Institute is the leading Slovenian institute with over 1000 employees, covering a broad spectrum of basic and applied research.

Stage of development

The technology has been demonstrated and tested in laboratory. The method needs to be scaled up.

Intellectual property

Patent application EP3795704A1 filed at the European Patent Office which issued relatively positive report about the patentability. Patent application based on same invention has been filed in China.

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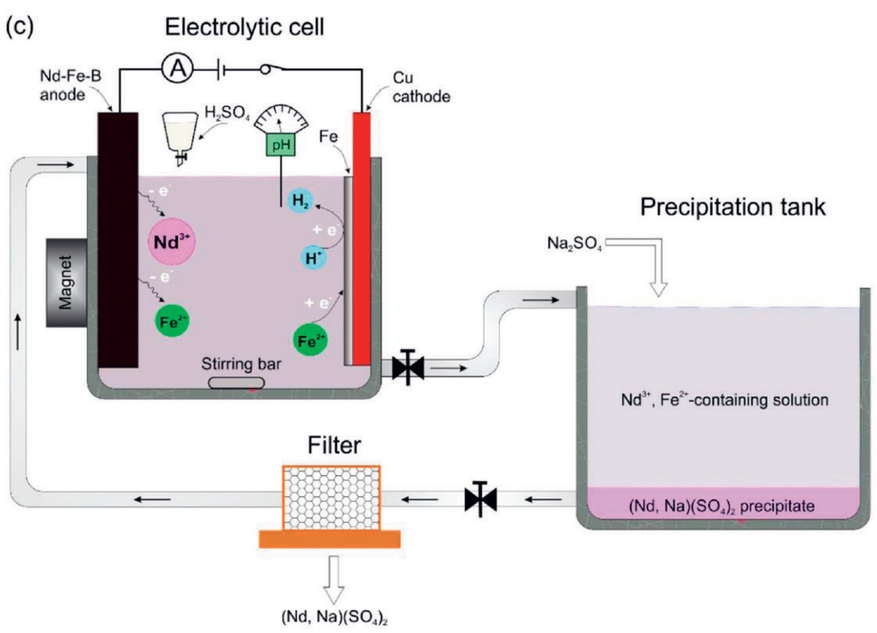

Figure 1. Schematical process of REE recovery

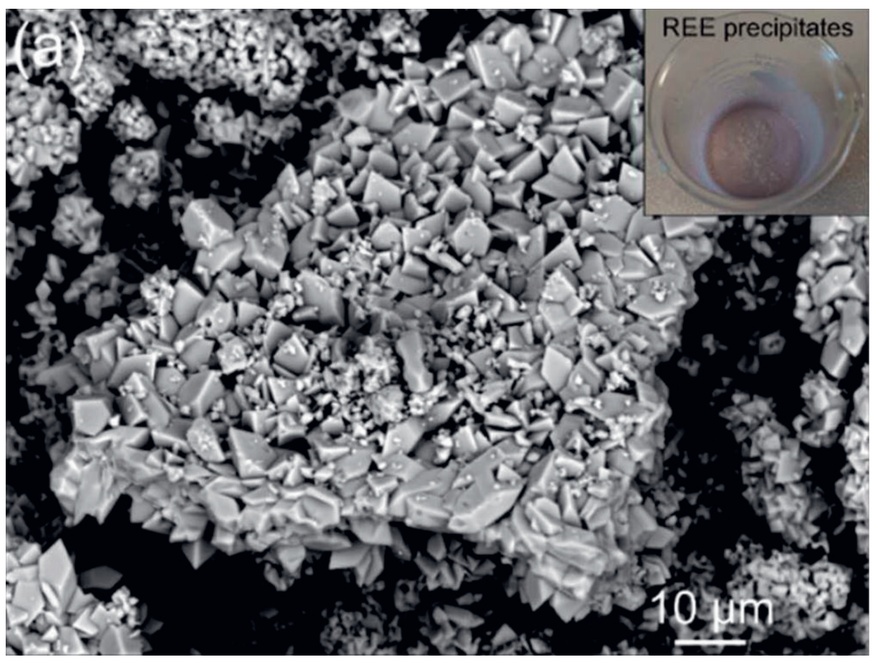

Figure 2. SEM picture of REE precipitates.

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The investment is co-financed by the Republic of Slovenia and the European Union under the European Regional Development Fund.