Iono and Pyrometallurgical aspects of Rare Earth Oxide Extraction and Separation

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Abstract

The rare-earth elements (REE) are a group of 14 elements, with $4f^n$ electronic structure, which can be divided into two groups - the lower atomic number (Z) "Light Rare Earth Elements (LREE)" from La to Sm and the higher (Z) "Heavy Rare Earth Elements (HREE)" from Eu to Lu. Amongst the REEs, several elements are strategically important because of their increasing use as magnets in consumer electronics, electric vehicles, hydrogen storage and catalysts for automobiles and petroleum refining. Although RE minerals are moderately abundant, they are scantly distributed in the Earth´s crust and as a consequence, difficult to extract in large quantities. On the other hand, the unique electronic structure of REE make them difficult to be substituted by other elements without compromising the device properties. In this work we have demonstrated the efficacy of rare-earth oxide separation from monazite minerals using alkali oxidation reaction above 700ºC. After water leaching of the roasted mass, the mixed rare-earth oxides can be separated as shown in Figure 1.

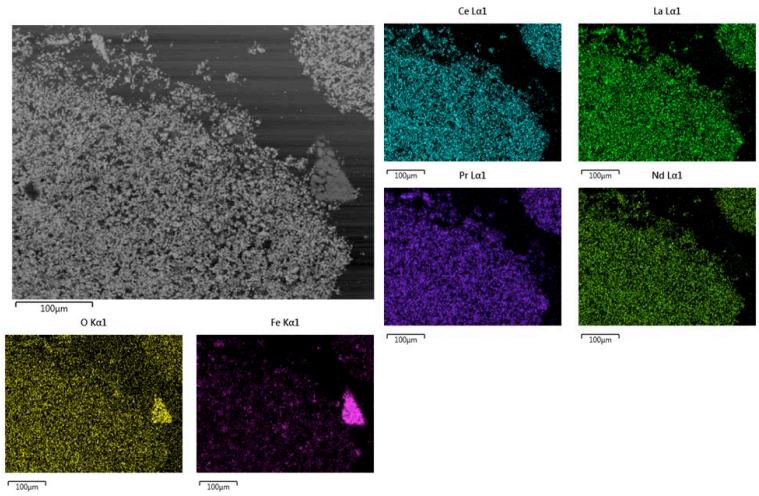

Figure1: Scanning electron microscopy image with elemental mapping of water leached monazite mineral.

We investigated cyclic voltammetric investigations on solubilizing pure RE-oxides into a deep eutectic solvent ethaline, for demonstrating the spectral changes for selecting the separation condition. The voltammogram spectrum clearly demonstrates selectivity using deep eutectic ionic liquid, ethaline which may be implemented for purifying the rare-earth oxide mixtures.

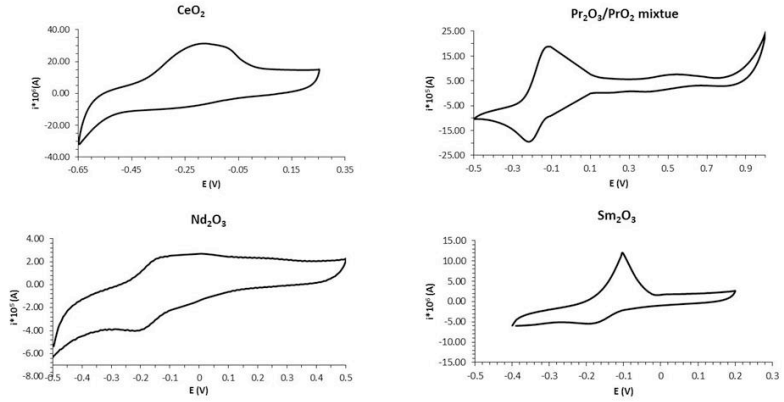

Figure 2. Cyclic voltagrams of different rare earth oxides in the deep eutectic solvent ethaline E200 measured at 50mV/s using Pt disc working electrode, a Pt flag counter electrode and a Ag/AgCl(0.1M) dissolved in ethaline reference electrode.

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