An innovative approach to study local dissolution mechanism of NdFeB permanent magnets by scanning electrochemical cell microscopy (SECCM)

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Abstract

The need for an efficient and sustainable recycling process for NdFeB permanent magnets (PMs) has grown rapidly due to latest regulation by the European Union, which has established that at least 25 % of the European consumption of critical-raw materials should come from secondary resources (recycling). Currently, different hydrometallurgical methods have been successfully developed to recover rare-earth elements (REEs) from spent NdFeB PMs. Recently, electroleaching (anodic dissolution) has been receiving increased attention as it enables the selective dissolution and enhances kinetics under electrochemical effect. Nevertheless, for a successful design of electroleaching process for NdFeB PMs it is of paramount importance to understand the dissolution mechanism of the different phases. Therefore, the objective of this work is to unveil the local dissolution mechanism of the different phases in NdFeB PM by means of scanning electrochemical cell microscopy (SECCM). SECCM is a local electrochemical technique with the main advantage of exposing only a small area of interest to the electrolyte. This area is determined by the size of the droplet which is influenced by the internal diameter of the tip (nm-µm range) and the surface wettability. In this work, we present the results of open circuit potential mappings, with more than 50 points acquired per map, using citric acid and acetic acid. Subsequently, the potential mappings were correlated with SEM-EDS analyses allowing the distinction of potentials within the microstructure.
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Key-words: critical-raw-materials; rare-earth elements; permanent magnets; NdFeB; electroleaching; scanning electrochemical cell microscopy