Direct Reuse of Rare Earth Permanent Magnets—Coating Integrity

Rare earth permanent magnets can be reused directly as an alternative to traditional recycling methods, in which scrapped magnets are reprocessed into new magnets by undergoing many of the original energy-intensive and expensive production processes. Direct reuse entails using segmented magnet assemblies built by several small standard-sized magnets that can be reused directly in a number of different applications. A central part of the direct reuse strategy is to separate and demagnetize magnets by heating them to the Curie temperature. We investigated the validity of direct reuse as a rare earth magnet recycling strategy by evaluating the extent to which the heat-driven demagnetization cycles affected magnetic properties, as well as the integrity of the protective coating of Nd–Fe–B magnets. The experimental investigation consisted of four different tests, and was applied to 300 magnets that had either been heated once, five times, or none at all. The tests included $J$–$H$ measurements, coating pull-off test, corrosion salt spray test, and optical microscopy of the interface between coating and magnet. Magnets coated with Zn, Epoxy, Ni–Cu–Ni, and Ni–Cu+Epoxy were investigated, of which Ni–Cu+Epoxy showed no degradation after heat treatment. Direct reuse as a recycling strategy could therefore be a valuable alternative to traditional recycling.