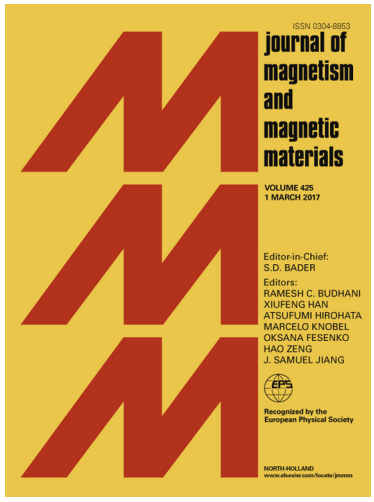

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Coercivity enhancement and grain refinement in Nd-Fe-B sintered magnets with pyrite doping by jet milling

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Abstract

In this paper, the methods to solve the uniformity problem of sulfur (S) element were studied in pyrite-doped Nd-Fe-B sintered magnets. With pyrite addition, the coercivity was enhanced, except for the magnets with pyrite doped by arc melting. Sulphur loss existed during the arc melting process. When pyrite doped by ball milling, the coercivity increased from 1236.3 kA/m to 1327.0 kA/m. The average grain size decreased from 9.10 μm to 7.9 μm. As a drawback, obvious sulfur clusters were formed. Jet milling was an effective way to achieve uniform distribution of S element. In the magnets with pyrite doped by jet milling, clear and continuous grain boundary phases were formed with smaller grain size. Correspondingly, the average grain size further decreased to 6.7 μm. A coercivity enhancement of 13.4% (1401.8 kA/m) was obtained with slightly decreasing in remanence and maximum magnetic energy product.

Keywords: Nd-Fe-B sintered magnets; coercivity; pyrite; jet milling; grain refinement

1. Introduction

Due to their excellent magnetic properties, Nd-Fe-B sintered magnets have attracted much attention in environmentally friendly applications, such as hybrid vehicles, electric vehicles, and wind power generators [1-2]. However, low coercivity is a major drawback in developing these anisotropic magnets [3]. Coercivity is an extrinsic property, which can be enhanced by increasing the anisotropy field of the $Nd_2Fe_{14}B$ phase and optimizing the microstructure [4-5]. This is commonly achieved through the introduction of heavy rare earth elements, such as Dy, to form a (Nd,