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RETENTION OF CRYSTALLOGRAPHIC ALIGNMENT DURING ROTARY FORGING OF PRE-ALIGNED GREEN COMPACT OF ANISOTROPIC $Nd_{15}Fe_{75.9}B_8Al_{1.0}Zr_{0.1}$ HDDR POWDER

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1. INTRODUCTION

It has been well kwon that Nd-Fe-B-type cast alloy can be converted into a magnetically coercive anisotropic material using a HDDR testament (1). Meanwhile, the rotary forging technique has been reported to be an effective means of consolidating Nd-Fe-B-type powder into a high density compact which can be used as a permanent magnet (2). It is expected, therefore, that the combination of the HDDR treatment and the rotary forging can be used as an effective means of producing an anisotropic Nd-Fe-B type permanent magnets directly from the cast alloys. In order that the combination can be utilised successfully as an effective means of producing an anisotropic Nd-Fe-B type permanent magnets, a retention of crystallographic alignment during rotary forging is essentially required. In the present study, the retention of crystallographic alignment existed in a pre-aligned green compact of anisotropic $Nd_{15}Fe_{75.9}B_8Al_{1.0}Zr_{0.1}$ HDDR powder during the rotary forging has been investigated.

2. EXPERIMENTAL WORK

The alloy with chemical composition $Nd_{15}Fe_{75.9}B_8Al_1Zr_{0.1}$ was HDDR treated under standard condition (hydrogenation at room temperature, disproportionation at 800°C for 2 hrs, desorption and recombination at 800°C for 1 hr and then slow cooling to room temperature under vacuum). The HDDR powder was aligned and then pressed into a green compact using an isostatic press. The green compact was then forged using a rotary forging machine. The magnetic

characterisation of the HDDR powder and the rotary forged magnets was carried out using a VSM and a permeameter. X-ray diffraction with Cr-Ka radiation was used in order to investigate the crystallographic alignment of the $Nd_2Fe_{14}B$ matrix grains in the green compacts and the rotary forged magnets

3. RESULTS AND DISCUSSION

The HDDR processed material was confirmed to be magnetically anisotropic. It was found that, for the rotary forged magnet produced using the pre-aligned green compact, the remanence value obtained along the forging direction was substantially higher than that along the other direction, indicating that the crystallographic alignment existed in the green compact was retained to a great extent even after the rotary forging.

The X-ray diffraction spectrum for the rotary forged magnets revealed that there was a significant shift in the intensities of the reflections from the planes perpendicular or parallel to the forging direction such that those reflections from the crystallographic planes with Miller indices having small h, k, and large l planes, such as (105) or (006), showed higher intensity for the perpendicular plane than for the parallel plane. Conversely, those reflections from the crystallographic plane with Miller indices having large h and small k, l, such as (410), showed the reverse trend. These results also indicate obviously that the magnetic alignment existed in the pre-aligned green compact can be retained to a great extent during rotary forging.

4. REFERENCES

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