Effect of quenching wheel speed on the magnetic properties of melt-spun NdFeM (M=B, Ti)

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1. Introduction

In last 60 years, the magnetically compounds composed of rare earth and 3d elements have been developed as high performance permanent magnets such as $SmCo_5$, Sm_2Co_{17} and $Nd_2Fe_{14}B$. In the 1960s, $SmCo_5$ compound appeared as the first rare earth high-performance magnets. This magnet has magnetic properties such as a large uniaxial magnetocrystalline anisotropy, a relatively high saturation magnetization, a high Currie temperature and very hihg maximum energy product. Subsequently, the $Nd_2Fe_{14}B$ compound was produced either by powdering/sintering in 1984 and the maximum energy product of this compound reached 36.25 MGOe. This $Nd_2Fe_{14}B$ magnet has been rapidly developed and then the magnet which has the maximum energy product value of 59.25 MGOe was produced. This magnet is the best permanent magnet in the present industry. Recently, permanent magnets are essential components in the many industries because of their ability to provide a magnetic flux and the magnetically hard alloys of nanocomposites with rare earth elements especially have attracted rapidly increasing interest. Nanocomposite magnets consisting of a soft magnetic α–Fe or Fe_3B phase exchange-coupled to a hard magnetic $Nd_2Fe_{14}B$ phase have been extensively studied due to their remanence enhancement effect, high energy product, and low cast. In this paper, we simultaneously investigate the hard magnetically compound and nanocomposite in one type compound by changing quenching wheel speed. We produce the NeFe-based compounds with various quenching wheel speed in order to study a transition from soft phase to hard phase.

2. Experiment

In order to ensure a homogeneous composition, ingots of NdFeM (M=B, Ti) were repeatedly melted and solidified under Ar atmosphere four times. These alloys were fabricated by melt spinning onto a cupper wheel at speed of 800 ~ 3000 rpm for rapid solidification. Melt spinning was carried out in an chamber with highly purified Ar atmosphere. The microstructure of the samples were characterized by XRD. The hysteresis loops was obtained a VSM due to study magnetic properties.

3. Result and discussion

Figure 1 and 2 display the XRD patterns and hysteresis loops of $Nd_2Fe_{14}B$ powders for wheel speed values of 2500 and 3000 rpm, respectively. 2500 rpm sample shows only $Nd_2Fe_{14}B$ phase, small coercivity and high saturation magnetization. The XRD pattern of 3000 rpm sample exhibits Nd_2Fe_{17} and Fe phases, 3000 rpm sample has large coercivity and low saturation magnetization.

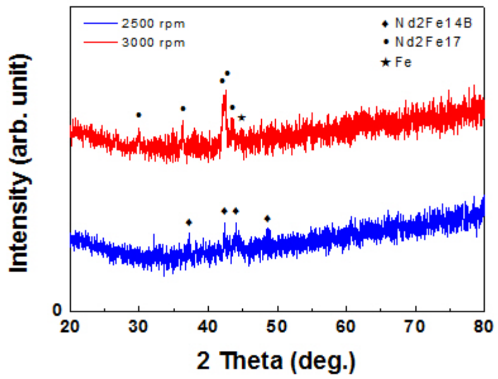

Fig. 1. XRD patterns of $Nd_2Fe_{14}B$ powders

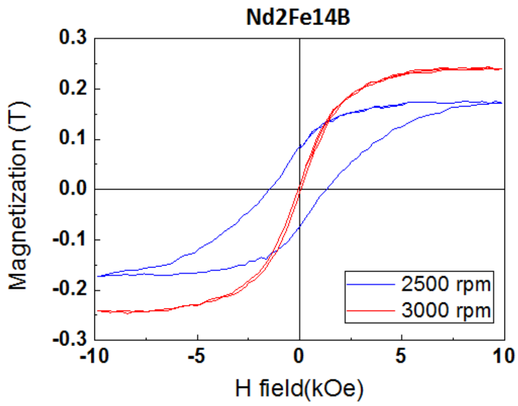

Fig. 2. Hysteresis loops of $Nd_2Fe_{14}B$ powders

4. References

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