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Improvement in morphology of multi-layered Nd-Fe-B/Fe_3B thick film magnets prepared by PLD method

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Introduction

Nanocomposite film magnets with the thickness of several tens of microns are one of hopeful candidates of magnets applicable to electronic devices. We have already reported that multi-layered nanocomposite film- magnets can be prepared by the Pulsed Laser Deposition (PLD) method with a rotating $Nd_{2.6}Fe_{14}B/Fe_3B$ composite target [1]. In this report, we reduced the size of droplets existing on the surface of a multi-layered Nd-Fe-B/Fe_3B thick film magnet, and improved its morphology.

Experimental

A composite target ($Nd_{2.6}Fe_{14}B/Fe_3B$) was ablated by a YAG laser beam (λ= 355 nm, P≅ 5.0 W) at the repetition rate of 30 Hz, and multi-layered films were deposited on a Ta substrate. During the deposition, a target was rotated with the speed of 7 rpm, suggesting that 840 layers are synthesized in 1 hour. As as-deposited films exhibited soft magnetic properties, they were annealed with an infrared furnace at 700 °C. The magnetic properties of the films were measured with a VSM. The_mMicrostructure of films was observed with a SEM. The compositions of films were studied with a SEM-EDX.

Results and discussion

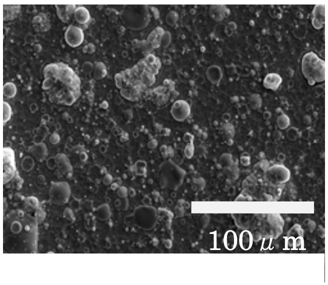
Figure 1 (a) shows a SEM photograph of the surface of the film deposited continuously for ablated that deposition time was 60 min. We can find particles larger than 20 μm. As the target is heated by the laser power under this deposition condition, we changed the deposition process. In the improved process, a film was deposited for 15 min. and the target was cooled to room temperature. Then, this cycle was repeated four times so that the total deposition time might become 60 min.

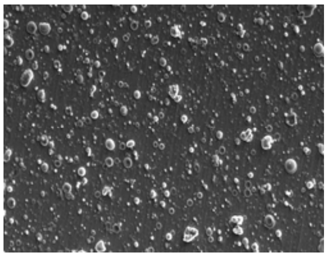
The SEM photograph of the films prepared by the improved process is shown in Fig.1 (b). It is clearly seen that the particle sizes of the film are much smaller than those of the film shown in Fig.1 (a), which suggests that suppression of an increase of the target temperature improves the surface morphology of PLD-made film magnets. maller than Fig.1(a).

As seen in Fig.2, magnetic properties were not affected significantly by the cooling process of the target. This result would be discussed from the viewpoint of the composition of droplets.

References

1. H. Fukunaga *et al.*, *J. Alloy. Compd.* 408 (2006) 1335.





(a) Continuous deposition (b) Discontinuous deposition

Fig. 1 Surface view of as-deposited $Nd_{2.6}Fe_{14}B/Fe_3B$ film magnets prepared by continuous and discontinuous deposition.

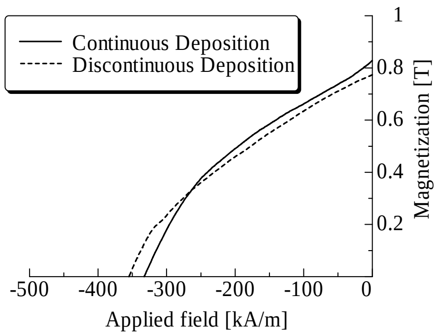


Fig.2 Demagnetization curves of crystallized multi-layered films prepared by continuous and discontinuous depositions.