Anisotropic NdFeCoZrBGa Magnet Powder with High properties Produced by Modified HDDR Process

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Abstract: The HDDR[1~3] (Hydrogenation-Disproportionation-Desorption-Recombination) process is a special method to produce anisotropic $Nd_2Fe_{14}B$-based powder for bonded magnet. Some authors[4] produced anisotropic magnet powder from the NdDyFeCoBZrGa alloy by modified HDDR process. The effect of the modified HDDR process on magnetic properties of $Nd_2Fe_{14}B$-based magnet with several composition and that of microelement Ga on B_r, $(BH)_{max}$, grain size and Disproporational temperature of $Nd_2Fe_{14}B$-based powder were investigated in order to produce anisotropic powder with high magnetic properties.

The materials which having the composition $Nd_{11.2}Fe_{66.5-x}Co_{15.4}B_{6.8}Zr_{0.1}Ga_x$ (x=0~1.0) were produced by conventional casting, and were homogenized at 1100℃ for 20h. The modified HDDR process (i.e., low vacuum dehydrogen treatment was appended between HD treatment and high vacuum dehydrogen treatment) was applied to them. X-ray diffraction studies were performed with Cu-Kα radiation.

It was found that the modified HDDR process is very effective to enhance magnetic properties of the powder and to fine grain size of major phase. B_r and ${}_jH_c$ of the powder depend on Low Vacuum treatment time. B_r increase with LV treatment time and on the other hand ${}_jH_c$ increase first and then decrease dramatically with LV treatment time. These results showed that the optimum LV treatment time is about 25 min . The modified HDDR process results in a much refined grain size and a very high B_r and $(BH)_{max}$ compared to those of the conventional HDDR. The appending of Ga improves B_r and $(BH)_{max}$ and reduces the grain size of the magnet powder and in the same time changes the disproportionation character remarkably of the alloy and improves disproporational temperature.

Key words: $Nd_2Fe_{14}B$; Modified HDDR process; Magnet powder; Grain size

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