# Coercivity of hot-pressed compacts of Nd-Fe-B- type HDDR-treated powder

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## 1. INTRODUCTION

The key feature of Nd-Fe-B-type HDDR (hydrogenation, disproportionation, desorption and recombination)-treated powder is the unique microstructure consisting of ultra-fine $Nd_2F_{14}B$ grains(~300 nm for $Nd_2F_{14}B$). This fine grain structure can be exploited for high coercivity in permanent magnet. The HDDR-treated material is generally in powder form, and it would be desirable if the material can be consolidated into a high density bulk magnetkeeping the fine grain structure. Our previous work revealed thatNd-Fe-B-type HDDR material lostthe coercivityradicallywhen the material was consolidated by hot-pressing. In the present study, the cause of radical coercivity reduction was investigated.

## 2. EXPERIMENTAL WORK

$Nd_{12.5}Fe_{80.6}B_{6.4}Ga_{0.3}Nb_{0.2}$ HDDR-treated powder (iHc =13.5 kOe) was used as a starting material. The hot-pressing was performed using different dieconfigurations (closed- or open-type). Magnetic characterization of the hot-pressed compacts was undertaken by means of vibrating sample magnetometer (VSM) with a maximum field of 12 kOe. Microstructure of the compact prepared in theclosed-type die was observed by SEM. Differential thermal analysis (DTA) was also carried out to investigate the phase change in the material during heating. X-ray diffraction (XRD) (Cu-$K_\alpha$ radiation) was usedfor studying thecrystallographic lattice parameter change in the$Nd_2Fe_{14}B$-type phase in the compact caused by the desorption of residual hydrogen.

## 3. RESULTSAND DISCUSSION

The coercivity in the compacts was influenced by evacuation system of dies and heating rate. In spite of identical hot-pressing temperature and heating rate,coercivity was radically reduced above 600 °C in the compacts prepared in the closed-type die compared to the compacts prepared in the open-type die. The coercivity in the compact prepared in the same die decreased with increasing the heating rate and the value further increased when high heating rate was employed. The HDDR-treated powder contained significant amount of residual hydrogen (approx.1500 ppm) in the form of $Nd_2Fe_{14}BH_x$ hydride. The radical coercivity reduction in the compact is believed to be attributed to the disproportionation of $Nd_2Fe_{14}BH_x$ hydride. Having considerable coercivity in the compacts prepared by the open-die is due largely to the effective desorption of hydrogen or suppressing hydrogen-related disproportionation on hot-pressing.

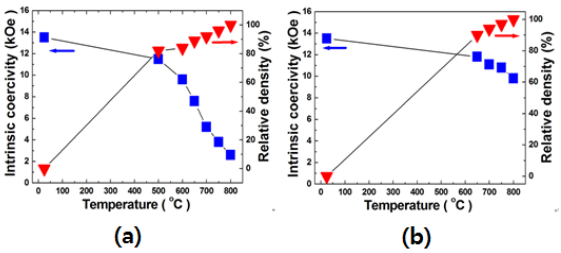


Fig. 1. Comparison of the coercivity and relative density of the hot-pressed compact of $Nd_{12.5}Fe_{80.6}B_{6.4}Ga_{0.3}Nb_{0.2}$ HDDR-treated powder prepared in the (a) closed- or (b) open-type die.