Nanocrystalline bonded NdFeB magnets produced from HDDR powders

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NdFeB magnets are based on the ferromagnetic phase $Nd_2Fe_{14}B$. The HDDR (hydrogenation, disproportionation, desorption and recombination) process[1] is one of the methods for producing high coercivity NdFeB powders. In the HDDR process, a NdFeB alloy consisting in the $Nd_2Fe_{14}B$ phase is kept under hydrogen atmosphere at low temperatures (100-200 ^oC), for hydrogenation. Then, at high temperatures, between 750 and 850 ^oC, the disproportionation is performed. The obtained phases are NdH_2, Fe_2B and alpha-iron. The hydrogen can be removed under vacuum at the same temperature, between 750 and 850 ^oC, and this is the recombination step. After this step the $Nd_2Fe_{14}B$ phase is obtained again. The alloy after the HDDR processing is nanocrystalline and present high coercivity, which is essential for magnet manufacture. In this study, ternary alloys Nd-Fe-B with different neodymium content were evaluated, with Nd amount varying between 29 and 36% of neodymium (wt %). Bonded magnets were produced with addition of 1.5 wt % of epoxy resin. It was found that alloys with higher amount of neodymium can present coercive field of 12 kOe. The anisotropy field for all alloys was estimated in 77 kOe, in spite of different chemical composition (neodymium content). Reasons for higher coercivity of neodymium rich alloys are discussed. Some excess of boron and neodymium can be necessary for obtaining a $Nd_2Fe_{14}B$ phase free of lattice defects as neodymium or boron vacancies.).

1 Ragg, O. M., Keegan, G., Nagel, H., Harris, R., Int. J. Hydrogen Energy, 1997, 22, 333.

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