Oxidation and Coercivity of Near Single Domain Size Nd-Fe-B-type Alloy Particles

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Fine particles of Nd-Fe-B alloy in near single domain size have increasingly found new applications for high performance micro-magnet. However, because of high oxygen-affinity and high specific surface area, the ultra-fine Nd-Fe-B-type particles are readily oxidized in air, hence causing a radical coercivity loss. In the present study, an ultra-fine Nd-Fe-B-type particles in near single domain size was prepared by ball milling of HDDR-treated Nd12.5Fe80.6B6.4Ga0.3Nb0.2alloy.The prepared near single domain size Nd-Fe-B-type powder (≒ 0.3 ㎛) had high coercivity over 9 kOe. However, the coercivity was radically reduced as the temperature increased in air (< 2 kOe at 200 ℃) (Fig. 1(c)). This radical coercivity reduction was attributed to the soft magnetic phases, α-Fe and Fe3B (Fig. 1(a), (b)), which were formed on the surface of the fine particles due to the oxidation. The magnetic soft phases (α-Fe, Fe3B) at the surface of fine Nd-Fe-B-type particle facilitate the nucleation of a reverse domain, hence reducing coercivity radically. Feasibilty of surface nitrogenation of the fine particles for improving the long-term stability of coercivity was studied. Long-term stability of coercivity of the nitrogenated fine powder was improved markedly. The nitrogenated powder showed no coercvity reduction even after 1 month in air at room temperature. In this article, the surface passivation of near single domain size Nd-Fe-B-type particles by nitrogenation for improving long-term stability of coercivity is to be discussed.

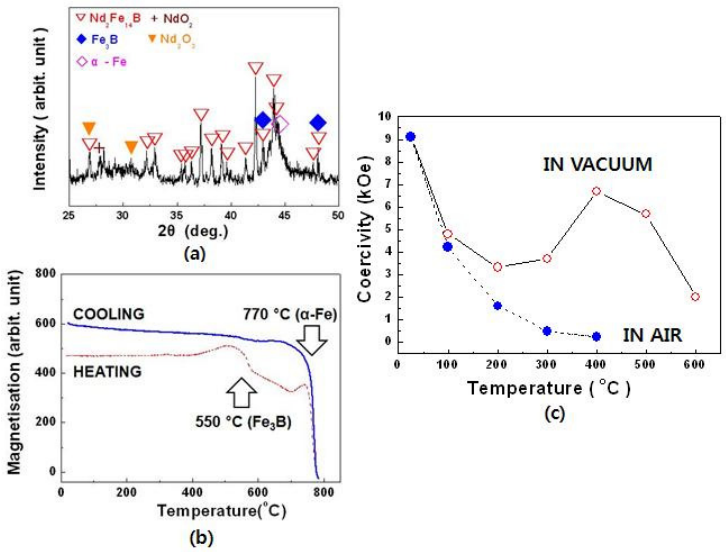

Fig. 1. XRD pattern (a) and TMA trace (b) of oxidised alloy, and the coercivity variation with temperature (c) for the near single domain size Nd-Fe-B-type powder.