Consideration about Coercivity Mechanism in Nd-Fe-B Sintered Magnets Based on the Surface Domain Structure Observations

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Nd-Fe-B sintered magnet is one of the most interesting materials especially for applications in EV and HV motor parts. This presentation deeply concerns to coercivity of the magnets, and that also relates to the serious Dy resource problem being watched recently. We investigated the magnetization and demagnetization mechanisms in Nd-Fe-B sintered magnets using EBSD, MFM, and Cs-TEM. The orientation of crystal grains mainly on c-plane (EBSD), domain structures of magnetized and demagnetized regions including the intermediate states (MFM), and the chemical composition and crystal and micro-structures including the thickness (Cs-TEM), all at the same position in the same magnet sample were studied. The propagation of magnetized and demagnetized regions surrounding the miss-orientated small number of grains was observed. The grain boundaries (GB) between (A) magnetized-magnetized grains and between (B) magnetized-demagnetized grains are similar thickness of 1.2-2.0 nm and similar amorphous structure including about 30% of Fe, except the different oxygen contents of 10% (A) and 40% (B) in the case of commercial NEOMAX-48 magnet. The relationship between microstructures and domain structures in the Nd-Fe-B sintered magnets are investigated using direct observations of incremental polished plane (each step; ~1μm thickness) and domain structure observation using MOKE on the plane, both on the same c-plane surface.

As conclusion, the magnetic states of surface grains are mainly governed by the magnetic flux from the inside grains, and the GBs ((A) and (B)) have no specific different characteristics as chemical composition and crystal structure (especially in the case of commercial NEOMAX-48 magnet).

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