High-coercivity Dy-free Nd-Fe-B permanent magnets

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Due to the recent concern about the stable supply of heavy rare earth elements, attaining high coercivity in Nd-Fe-B magnets without using Dy has received intense research interest. In this talk, we will overview our recent progresses at NIMS toward the development of high coercivity Dy-free Nd-Fe-B permanent magnets. To obtain better understandings of the microstructure-coercivity relationships, we revisited the microstructures of Nd-Fe-B sintered and hot-deformed magnets using aberration-corrected STEM complemented by atom probe tomography (APT), magneto-optical Kerr microscopy and finite element micromagnetic simulations. We found that the intergranular phase parallel to the c-planes are mostly crystalline with a higher Nd concentration in contrast to that lying parallel to the c-axis that contains higher Fe content with an amorphous structure. Micromagnetic simulations suggest the reduction of the magnetization in the latter is critical to enhance the coercivity. Based on these new experimental findings together with our recent detailed characterization results of the intergranular phases in Ga-doped Nd-Fe-B magnets, we developed a method to increase the coercivity of Nd-Fe-B hot-deformed magnets while keeping relatively high remanence.