A Fundamental Look at the Lab-to-Fab Transition of a New Permanent Magnet

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Keywords: Permanent Magnet Materials

$SmFe_{12}$ ($ThMn_{12}$, *I*4/*mmm*) compound has excellent intrinsic magnetic properties, superior to the current high-end-magnet $Nd_2Fe_{14}B$ compound.[1] Yet, the synthesis of $SmFe_{12}$-based bulk materials with sufficiently large coercivities (H_c) for fabricating permanent magnets has not been realized. The most obvious obstacle to improving H_c is critical issues of microstructure, especially the inevitable formation of magnetically-soft $SmFe_x$ surface.

Recently, we have already succeeded in preparing $Sm(Fe,Co,Ti)_{12}$ microparticles with ever-larger H_c and remanence (M_r) based on precise control over their microstructure by advanced chemical synthesis, opening a new era of $SmFe_{12}$-based permanent magnet materials.[2,3] In particular, synthesized $Sm(Fe,Co,Ti)_{12}$ microparticles possessed various surfaces from Sm-enriched and Ti-enriched surfaces to a depleted surface (Fig. 1A), and $\mu_0 H_c$ and $\mu_0 M_r$ values of their isotropic powders at 300 K were as large as 1.6 T and 1.2 T, respectively (Fig. 1B).

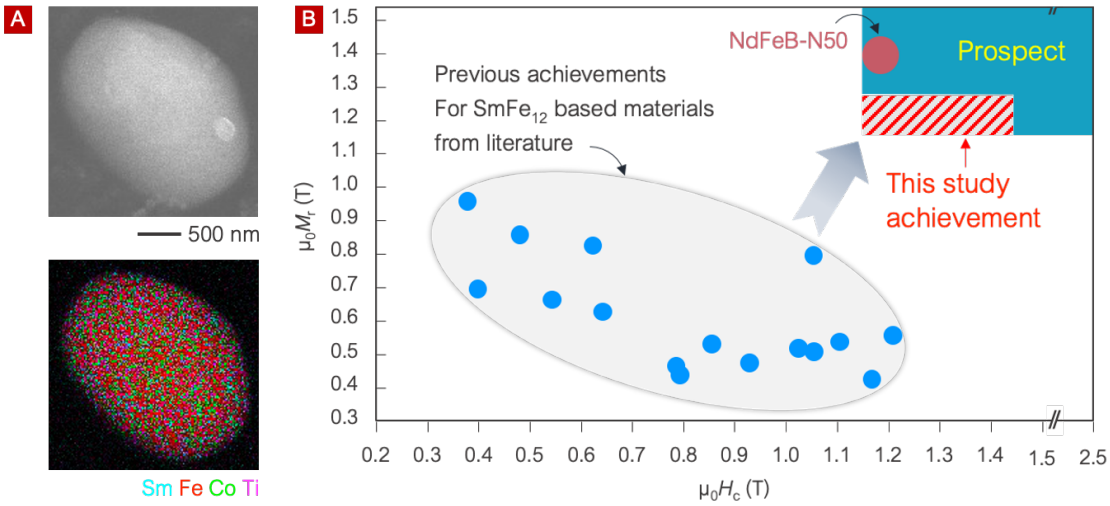

Fig. 1 A. SEM image and EDS elemental map of a $Sm(Fe_{0.8}Co_{0.2})_{11}Ti$ microparticle. B. Extrinsic magnetic properties of isotropic $Sm(Fe_{0.8}Co_{0.2})_{11}Ti$ micropowders at 300 K. NdFeB-N50 is a commercial $Nd_2Fe_{14}B$-based magnet.

1. T. T. Trinh *et al.*, *Sci. Technol. Adv. Mater.* 2021, 22, 37–54.
2. 特願 2021-079367
3. T. T. Trinh *et al.*, Manuscript in preparation.