Exchange coupling behaviors between Sr-hexaferrite and $LaSrMnO_3$ composites

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A large number of studies have been performed on magnetic hard-soft composites for not only improving their hard magnetic performance, but also for studying the origin of this phenomenon because of their potential applications in high-performance magnets, magnetic recording devices, and sensors. [1-4] Although both the M-type hexaferrites and perovskite manganites have been studied intensively, the magnetic coupling behavior of composites of the two phases has been rarely reported.

In this study, composites consisting of a magnetic hard SrM and a magnetic soft LSMO were prepared by conventional solid-state reaction methods using two different routes. In the first route (route A), the SrM and LSMO powders, synthesized by calcination (1100°C), were first mixed in a 1:1 ratio (wt%). Then, the mixed powder was ground, pelletized, and calcined at 1200 °C for 2 h. In the second route (route B), the precursor powders of $SrCO_3$, La_2O_3, Fe_2O_3, Mn_3O_4 were weighed such that they had the same cation ratio as the composite made by the first route (50 wt.% SrM + 50 wt.% LSMO). The weighed mixture of the powders was ball-mixed, and subsequently calcined at 1100°C for 4 h and at 1200°C for 2 h. Analysis by X-ray diffraction (XRD-7000, Shimadzu) and field emission scanning electron microscopy (FE-SEM, JSM-7610F) were performed for phase identification and microstructural observation, respectively. Magnetic hysteresis curves were measured using a physical property measurement system-vibrating sample magnetometer (PPMS-VSM, Quantum Design) at 300 K with a sweeping magnetic field (H) within ±2 T.

When the LSMO-SrM composite was synthesized directly from the initial precursor powders, it shows a single hysteresis where the hard-soft phases are exchange-coupled. On the other hand, clear double hysteresis without magnetic coupling was observed in the composite prepared by calcination of the mixtures of LSMO and SrM powders. It is suggested that microstructural and compositional differences between the composite samples may give rise to such a difference in the magnetic behaviors.

References

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