Characterization of Ca-La M-type hexaferrites synthesized by solid state reaction

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Ca-La M-type hexaferrites were reported to exhibit high saturation magnetization ($M_s$) and coercivity ($H_c$) comparable with M-type hexaferrites. In this study, we tried to synthesize Ca$_{1-x}$La$_x$Fe$_{12}$O$_{19}$ and influence of the iron content in the formation process of Ca$_{0.5}$La$_{0.5}$Fe$_{12-y}$O$_{19-\delta}$ (0.75 $\leq$ y $\leq$ 2.15) hexaferrite prepared by solid state reaction. Lanthanum oxide (La$_2$O$_3$), calcium carbonate (CaCO$_3$) and iron oxide (Fe$_2$O$_3$) were used as raw materials for solid state reaction. In this case, the raw materials were mixed by ball-milling for 24h, and were uniaxial pressed into disks. The precursor disks were calcined at 1200–1300°C for 12 h in air and whole process was repeated twice. The pellets were sintered at 1275–1325°C for 4 h. The samples were characterized by X-ray diffraction (XRD), vibrating sample magnetometer (VSM), and scanning electron microscope (SEM).

All XRD patterns of analyzed Ca$_{0.5}$La$_{0.5}$Fe$_{12-y}$O$_{19-\delta}$ (1.75 $\leq$ y $\leq$ 2.15) ferrite obtained in the calcined at 1250 for 12 h and 1300°C for 12 h have single phase hexagonal crystal structure. For the single phases of Ca$_{0.5}$La$_{0.5}$Fe$_{12}$O$_{19-\delta}$ obtained at each sintering temperature, the lattice parameter a, c and unite cell volume are decreased first and increased when y is increased. The maximum $M_s$ value is 77.5 emu/g for the sample of Ca$_{0.5}$La$_{0.5}$Fe$_{11.25}$O$_{19-\delta}$ sintered at 1300°C for 4 h in air. Detailed magnetic properties of M-type hexagonal ferrites will be presented for a discussion.

Keywords: Ca-La ferrite, Hexaferrite, magnetic property