Characterization of Nanocrystalline Fine $MgFe_2O_4$ Soft Ferrite Powder Synthesized by Ultrasonic Spray Pyrolysis Method

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Ultrasonic spray pyrolysis (USP) has been successfully used to synthesize fine ceramic particles with several advantage such as convenient, controllable and continuous process [(1)]. In the present work, nano-magnetic unsintered magnesium ferrite as dried powder has been synthesized using ultrasonic spray pyrolysis technique without any additives and post-annealing processes. Magnesium ferrite is a very useful soft magnetic ceramic material and it expected to be suitable for local hyperthermia when compared with other ferrites [(2)]. Spherical nano-sized magnesium ferrite powders were obtained using ultrasonically atomized aqueous solutions of iron (III) nitrate and magnesium nitrate mixture followed by thermal decomposition of dried mist in nitrogen atmosphere. Different pyrolysis temperature applied to the reactor furnace was found to have a significant impact on the crystallinity and morphology of the magnesium ferrite powders.
Structural characterization was carried out using x-ray powder diffraction (XRD) method to evaluate crystallographic analysis and crystallite size. Figure 1 shows that all the samples are single phase cubic ferrites particles with the space group Fd-3m and lattice constant vary from 0.829 nm to 0.838 nm with increasing pyrolysis temperature from 600 °C to 800 °C. Crystallite size of the nanoparticles increased from 5.24 ± 51 to 15.97 ± 45 nm when pyrolysis temperature increased from 600 °C to 800 °C. Formation of ferrites was examined using Fourier transform infrared spectroscopy (FT-IR). The nanocrystallite nature and morphology of the as dried powder was evidenced by transmission electron microscopy (TEM) (Fig. 2). The effects of the pyrolysis temperature on the particle size distribution were investigated using laser particle size analyzer. Results showed that particle sizes were decreased from 253 nm to 67 nm by increasing pyrolysis temperature from 600 °C to 800 °C and also narrower size distribution was obtained using higher pyrolysis temperature. The agglomerates observed by field-emission scanning electron microscopy (FE-SEM) proved that $MgFe_2O_4$ nanocrystallites shows high dispersibility. Also, particles prepared at 800 °C had less aggregated structure than those prepared from 600 °C to 700 °C. The composition examined using energy-dispersive spectroscopy (EDS) was stoichiometric. Magnetic properties of synthesized $MgFe_2O_4$ powder were examined using VSM.

Reference:

1) Kang et al. *Mat. Sci. Eng. B*, **127** (2006) 99.
2) Franco et al., *J. Appl. Phys.*, **109** (2011) 07B505.

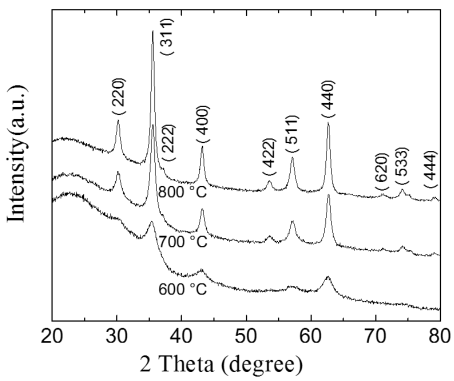

Fig. 1. XRD patterns of Mg-ferrite nanoparticles synthesized at various pyrolysis temperature.

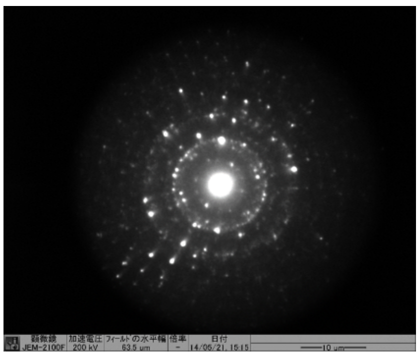

Fig. 2. SAED pattern of Mg-ferrite nanoparticles synthesized at 600 °C.