Study on the Synthesis Mechanism and Magnetic Properties of Quasi-nano Sized Ba-Mg Ferrite Powders Formed by Self-propagating High Temperature Synthesis

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Quasi-nano-sized $Ba_xMg_{1-x}Fe_2O_4$ ferrite powders for a magnetic absorber were prepared by using self-propagating high temperature synthesis (SHS) with different initial powder composition and oxygen partial pressure [1, 2]. Combustion temperature and propagating rate were in the range of 930 to 1115 K and about 4.5 to 6.4 mm/sec, respectively. The final ferrites size was about less than about 200 nm. X-ray and neutron beam analysis showed that amount of spinel peaks increased with the ratio of BaO to MgO. As the ratio of BaO to MgO in the initial powder composition varied from 0.25 to 1.0, maximum magnetization (Ms) increased about 26 %, whereas, residual magnetization (Mr) and coercive force (iHc) decreased about 3% and 50%, respectively. As oxygen pressure of a specimen with unit ratio of BaO to MgO during SHS reaction was changed from 0.5 MPa to 1.0 MPa, maximum magnetization (Ms) increased about 60%, whereas, residual magnetization (Mr) and coercive force (iHc) decreased about 3% and 59%, respectively. Considering a numerical modeling about the SHS reaction, the observation of microstructure and chemically analysis of the products, the variation of magnetic properties was related to the spinel formation due to oxygen pressure during SHS reaction and different non-stoichiometric numbers of the ferrites due to the competitive reduction reaction between barium and magnesium oxides.

[1] J. S. Lee, et al. Applied Physics A : Materials Sc. & Processing 74 (2002) 568.
[2] Y. Choi, Phisica B, 327 (2003) 229.