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New Synthetic Route of Single-phase Z-type ($Ba_3Co_2Fe_{24}O_{41}$) Hexaferrite Particles

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Z-type hexaferrite ($Ba_3Co_2Fe_{24}O_{41}$: Co_2Z) has recently attracted great attention because of its high ferromagnetic resonance frequency in the rage of MHz to 5 GHz [1] and high permeability of about 15 at 1 GHz [2]. Accordingly, microwave devices such as MHz - GHz antenna and MHz inductor based on the Co_2Z-type hexaferrite are emerging. There have been several attempts to synthesize the Z-type hexaferrite particles, including coprecipitation and ceramic processes [3-5]. All these processes involve several phase trasformations, such as starting materials → $BaFe_2O_4$ → $BaFe_{12}O_{19}$ (M-type hexaferrite) → $Ba_2Co_2Fe_{12}O_{22}$ (Y-type hexaferrite) → $Ba_3Co_2Fe_{24}O_{41}$ (Co_2Z: Z-type hexaferrite), before the starting materials are converted to the Z-type phase. None of these processes is simple and cost effective. Therefore, we have developed a new process, called one-step mixing-firing process. A mixture of M-type ($BaFe_{12}O_{19}$) and Y-type ($Ba_2Co_2Fe_{12}O_{22}$) hexaferrite powders was shake-milled, then followed by firing of the milled hexaferrite mixture at 1300 °C in O2 enviroment. The fired power was characterized by VSM and X-ray diffractometry for magnetic properties and ceramic phase identification. X-ray peaks shown in Fig. 1 are well indexed to starting M- and Y-type and synthesized Co_2Z-type hexaferrites, and confirm single phase of all hexaferrites. As shown in Fig. 2, the starting M- and Y-type hexaferrites show hard magnetic properties, while the Co_2Z powder exhibits soft magnetic properties. The coervicity and saturation magnetization of the Co_2Z powder were 19.2 Oe and 48.1 emu/g at 10 kOe, respectively, that is close to theoretical value of 50 emu/g. These results imply that our new process is potentially applicable to synthesis of any other ferrite and also cost effective. We will present phase transformation mechanisms and magnetic properties of sintered Z-type hexaferrite for use in microwave antenna.

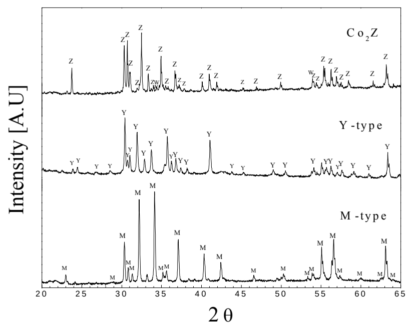

Fig. 1. XRD spectral of synthesized ferrite powders.

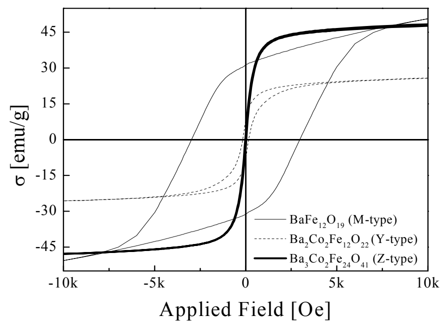

Fig. 2. Magnetizations of synthesized ferrite powders.

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Lightweight Optimum Design of a Novel Type of Electromagnet in Magnetic Levitation System for Contactless Delivery Application

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A novel type of electromagnet, the use of permanent and electro magnets for levitation, is good solution to reduce its control power loss but still have some limits on stable dynamic operating range because the PM with electromagnet increases reluctance of magnetic path [1],[2]. A new scheme of levitation magnet, PM with electromagnets is proposed as in Fig. 3. Design of this hybrid magnet and control results on magnetically levitated vehicle with 160 kg is presented in order to prove stable operation and low power consumption. Electromagnet is being charged considerable 10 % parts in whole weight, which can largely affect influence the lightweight and stability of the magnetic levitation system. Then, it accomplished the optimum plan for the lightweight of electromagnet in magnetic levitation system. This paper presents optimum design of electromagnet for lightweight using RSM. For each design variable combination the response value is determined by 2D, 3D FEM. Fig. 3 shows design variables. The proposed 3 response equations of approximate 2 order polynomial easily can design a novel type of electromagnet and control ratio of PM force and PM+EM force. Fig. 1 shows prototype. Fig. 2 shows comparison of FEM and Experiment.

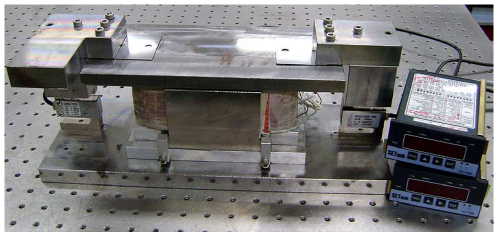

Fig. 1. Reference model prototype of electromagnet.

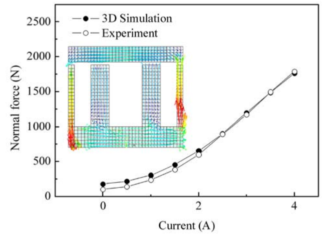

Fig. 2. Comparison of FEM and experiment.

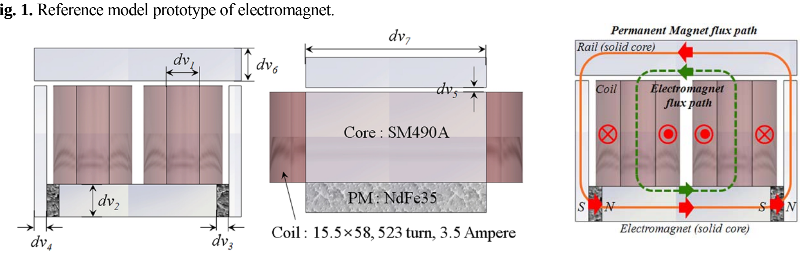

Fig. 3. A novel type of electromagnet and design variables.

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