## TE12

# Synthesis and magnetic properties of nano Ba-hexaferrite/NiZn ferrite composites

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In recent, there has been a tremendous increase in the investigation of magnetic properties of exchange coupled systems such as exchange biased and exchange spring systems. Contrary to the exchange biased systems, the exchange spring systems of soft and hard ferromagnets, which was proposed by Kneller and Hawig [1], have not been progressed rapidly because of a lack of effective fabrication methods. For the exchange spring systems, it is required to achieve homogeneously distributed soft and hard nano-ferromagnets, which was suggested as the most effective structure for the exchange-spring systems. [2] Up to now, a bi-layered thin film structure has been still used to investigate the physical behaviors of the exchange-spring systems. Therefore, we aim to develop the synthesis method of nano-sized Ba-hexaferrite (hard magnet)/NiZn ferrite(soft magnet) composites and characterize their properties.

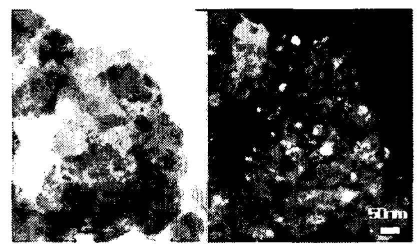


**Fig. 1.** Bright and dark field TEM image of Ba-hexaferrite/NiZn ferrite powders

In this experimental, composite materials of Ba-hexaferrite/NiZn ferrite were simultaneously fabricated by a self-propagating combustion method. In this synthesis, iron nitrate [$Fe(NO_3)_3$ $9H_2O$], nickel nitrate [$Ni(NO_3)_2$ $6H_2O$], zinc nitrate [$Zn(NO_3)_2$ $6H_2O$], Barium nitrate [$Ba(NO_3)_2$] *and glycine* [$NH_2CH_2COOH$] *were selected as raw materials for making Ba-hexaferrite/NiZn* ferrite powders. To obtain a homogeneous mixture structure of Ba-hexaferrite and NiZn ferrite, all of the metal nitrates were simultaneously dissolved in de-ionized water and then an ammonia solution was added to adjust pH 7of the nitrate solution. The solution was slowly evaporatedat 80℃ until it became a viscous gel type. With the further temperature increment of the solution up to about 100℃, the viscous gel turned into a dry gel type. This dry gel was ignited in air and burned into a brittle powder. And then calcination was carried out in air at 750℃ for 1hr to obtain a ferrite structure. The calcined powders were ground with high energy ball milling for 40 hr. XRD analyses showed that these calcined ferrite powders had spinel and magnetoplumbite structure. As shown in Fig. 1, TEM micrographs also revealed that the composite have a particle size of 20-30 nm. And then these calcined powders were sintered at 900℃ for 2 hr. After sintering, the variation of Ms values of the Ba-hexaferrite/NiZn nano-composites were measured. As a result, the Ms values of the sinteried composites were shown to be higher than the theoretically calculated Ms values of mixed composites. Therefore, this self-propagating combustion method is proven to be an effective method for obtaining the exchange-spring effect of soft and hard magnets.

**REFERENCES**

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