CT05

Non-zero Intercept in Kittel's Scaling Law for Nanostructured 180° Stripe-domains

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It has been know for a long time that the equilibrium value of the stripe period D is exactly proportional to the square root of the crystal thickness t [1], which is called as Kittel's law in literature. In this paper, by assuming a linear change of magnetization/polarization in the 80° stripe domain-walls, it is found for the first time that a negative intercept turned up which modified Kittel's scaling law. As a result, the periodicity of 180° stripe-domains D relates to the wall width d and the film thickness t as $D^2 = \rho dt - \pi^2 d^2/8$. The itercept term, $-\pi^2 d^2/8$, is negilible for thick films but is important when the film goes to the nanoscale. Experimental evidences of non-zero intercept could be found in literatures for ultrathin films of Co, $LaSrMnO_3$, $PbTiO_3$, $BaTiO_3$ and others. Fig. 1 shows the experimental data for Co thin films obtained by Hehn *et al.* [2]. It can be seen there is a linear relationship between the square of the domain period D^2 and the film thickness t when t changes from 25 nm to 500 nm. Close inspection shows that negative intercept does exist in this thickness region. The domain period, wall width and other important parameters of the material could be obtained reliably from the fitting of the experimental data.

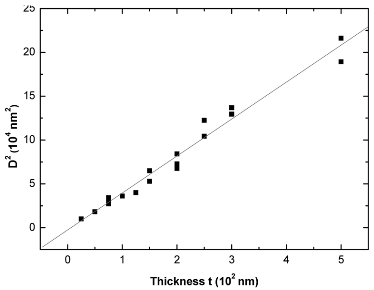

Fig. 1. Experimental evidence of linear relationship with non-zero intercept in Cobalt.

This work is supported by National Natural Science Foundation of China under contract number 10747007.

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CT06

The Mechanical Analysis for an Improved Discrete Configuration of Halbach Magnet

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Halbach magnets [1] provide a strong and homogeneous magnetic field for NMR equipment. The magnet is built from segments with the different cross-sectional shapes. The ideal magnetization direction is approximated by the directions of the assembly of segments with the strong mutual forces.

A Halbach magnet with a discrete crescent-shaped configuration (Fig. 1) is presented to improve the homogeneous fields [2], on other hand, and the mechanical characteristic.

The simulation analysis is accomplished with the MAXWELL 2D. The magnetic material is assumed to be FeNdB, and uniformly magnetized. For mechanical characteristic simulation, the force and torque of each segment is calculated. Figure 2 shows the torques of sector-shaped and crescent-shaped segments. Figure 3 shows the forces of sector-shaped and crescent-shaped segments.

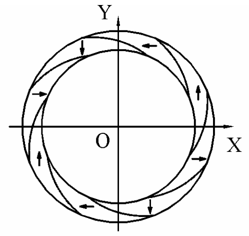

Fig. 1. The improved Halbach magnet.

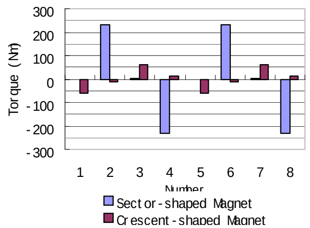

Fig. 2. The torques of sector-shaped and crescent-shaped segments.

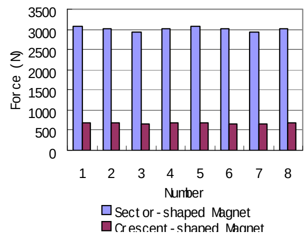

Fig. 3. The forces of sector-shaped and crescent-shaped segments.

The results depicted in Fig. 2 and Fig. 3 illustrate the mechanical performance of crescent-shaped segments is significantly improved. The improved Halbach magnet is easily assembled. A portable NMR instrument might greatly benefit from the improved configuration.

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