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HYSTERESIS LOOP AND MAGNETIZATION PROCESS OF MELT-SPUN $Nd_{13}Fe_{77}B_{10}$

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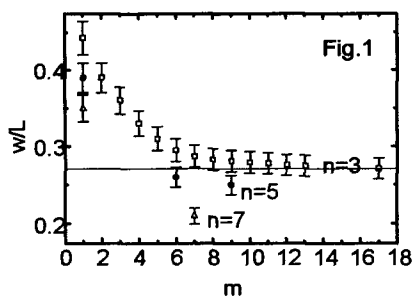
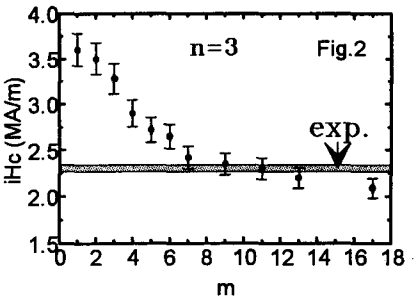
Hysteresis loops of melt-spun $Nd_{13}Fe_{77}B_{10}$ was measured at 4.2 K and 250 K. The loop and the demagnetization process at 250 K were analysed by the micromagnetism. The model magnet contains $n \times n \times n$ cubic $Nd_2Fe_{14}B$ grains. The grains are randomly oriented. Each grain is exchange coupled with adjacent grains and consists of $m \times m \times m$ cubic single domain elements. J was obtained from minimization of the following micromagnetic energy function with respect to $\{\vec{A}(i), \vec{J}_s(i)\}$ [i=1,2, · · ·,$(n \times m)^3$].

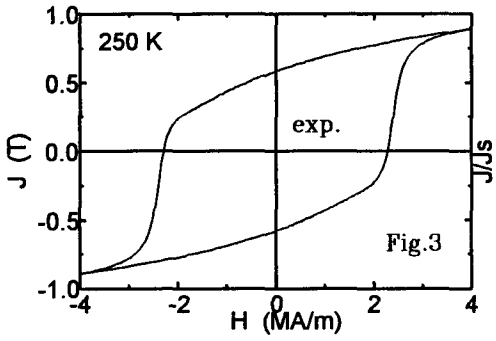
$$W[\vec{J}_s, \nabla \times \vec{A}] = \sum_i [K_1 \sin^2\theta(i) + K_2 \sin^4\theta(i) + K_3 \sin^4\theta(i)\cos[4\phi(i)] - J_s(i) \cdot H -$$

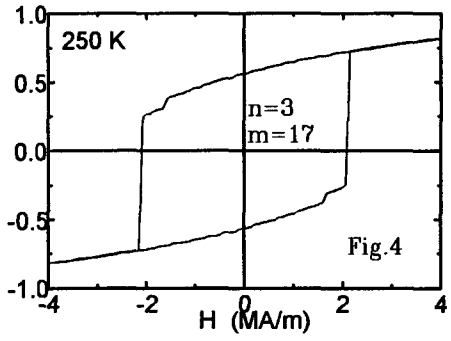
$$- \frac{1}{2} \frac{w}{\mu_0} \frac{m}{L} \sum_{adjac.} J_s(i) \cdot J_s(\text{adjacent element}) + \frac{1}{2\mu_0} (\nabla \times \vec{A}(i) - \vec{J}_s(i))^2].$$

Fig. 1 shows w/L versus m which was obtained from fit of computed ${}_iH_c$ with the experimental value at 4.2 K. Figure 2 shows ${}_iH_c$ versus m. The limit of 2.1 MA/m is fairly close to the experimental value (figure 3). Figure 4 shows the computed loop for n=3 and m=17, which simulates the experiment fairly well quantitatively. The step, however, is reproduced unsatisfactorily. For better simulation of the step, increase of n is necessary (figure 5). Figure 6 demonstrates the spin distribution.









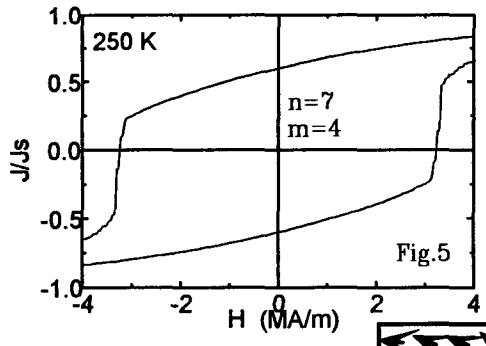
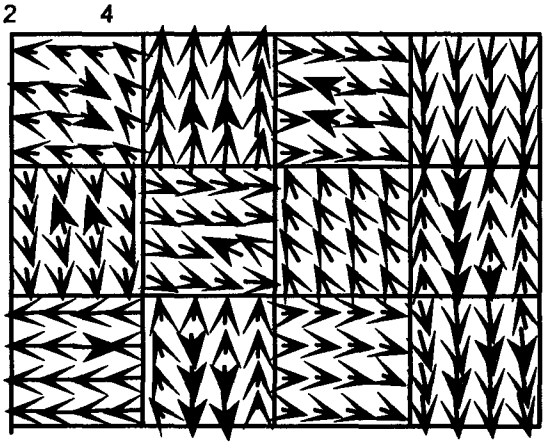


Fig. 6
n=7
m=4
H=−3.42 MA/m
J/Js=−0.545



H is perpendicular
to the paper
lengh of arrow
=projection of m
vector on the paper
Bold arrow: m>0
thin arrow: m<0