THE PARTICLES INHOMOGENEITY DEPENDENCE OF SWITCHING FIELD DISTRIBUTION FOR A REAL ASSEMBLY OF PARTICLES.

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A new technique to determine the switching field H_{sw} distribution (SFD) in a heterogeneous magnetic sample consisting of uniaxial particles has been developed This technique involves saturating the sample with the magnetic field H_s applied parallel to the preffered orientation R of particles. Then the field is removed, and the specimen is rotated by a small angle $\Delta\theta=\theta_1$. The field is then cycled from zero to H_{1i} and back to zero, increasing H_{1i} for consequative cycles until $H_{1i} \geqslant H_s$. Up to here, the procedure in our method is the same as in [1]. Then our technique involves measurements of angles δ_{1i} of the remanence vector-moment M_r orientations with respect to R1, where R1 is the new R direction after the sample rotation. After $H_{1i}=H_s$ the specimen is rotated by an additional angle $\Delta\theta$ so that $\theta_2=2*\Delta\theta$. Repeating all measurements until the $H_{2i}=H_s$ gives the new sets $\{H_{2i}\}$ and $\{\delta_{2i}\}$. Measurements of all this quantities for n directions until $\theta_n=n*\Delta\theta=90^o$ we arrive at the sets of data in the following form: θ_j, $\{H_{ji}\}$ and, respectively, $\{\delta_{ji}\}$, where $1 \leq j \leq n$, $H_1 \leq H_{ji} \leq H_s$, δ_{ji} - the angle between M_r and R_j after the application and removal of the field H_{ji}. All angles δ_i have been determined with a vibrating-sample anisometer. These results can be used for a quantitative study of SFD and an orientational distribution of the easy axes. Preliminary calculations are based upon the Stoner-Wholfarth theory. For each j,i,l have been calculated the relative volume $P_j(H)_{il}*(H_l-H_i)$ of the particles with H_k in the interval $[H_i \leq H_k \leq H_l]$ to the $\Delta\theta$ -partial volume of the particles, oriented in interval $[90^o-\theta_j<\theta<90^o-\theta_{j-1}]$. Summing over all l gives the orientational distribution $P(\theta_j)=\sum_{l=0}^{s-1} P_{l,l+1}(H_{l+1}-H_l)*\{\sum_{j=1}^{n} P(\theta_j)\Delta\theta\}^{-1}$. Here $P(\theta_j)$ is the ratio of $\Delta\theta$-partial volume with reference to the total volume of the specimen.

In another way, summing $P_j(H)_{jl}$ over all θ, i, l and taking into account the angular dependence of the H_{sw} for each particle gives the expression for the sum S(H). Here S(H) is the analog for $P_1(H)$ where $\theta_1=90^o$ and corresponds to the coherent rotation model. Finally, measuring of all quantities $\{H_i\}$, $\{\delta_i\}$ for $\theta_1=90^o$ in the case of real assembly gives the expression for Q(H). S(H) is equal to Q(H) for each H if only the sample is formed by single-domain particles. In any other cases the difference in the S and Q is a measure of the proportion of material for which incoherent reversals play an important role.

Reference.

1. Flanders P.J., Shtrikman S., J.Appl.Phys., 33,(1962), 216.