FORC diagrams identification of magnetization time dependent effects

Laurentiu Stoleriu[1], Alexandru Stancu[1]

[1]Faculty of Physics and CARPATH Center, “Alexandru Ioan Cuza” University of Iasi, Romania

FORC diagrams have been used recently to extract intimate information form a wide range of magnetic systems due to high sensitivity of this method compared to other magnetometry measurements, like MHL or deltaM curves.

We have used the FORC method to study interaction distributions in single [1] or multi-phase systems [2, 3], to discuss identification methods in general [4], or separately for reversible magnetization processes [5] but little attention has been paid to magnetization time-dependent effects on the diagrams, especially due to the difficulty of the problem, while those effects partially overlap the reversible phenomena in both the magnetization curves and the FORC diagrams.

Here we propose a study on how relaxation skew the FORC diagrams and we discuss possible strategies of separating the time-dependent effects in order to unveil the underlying quasistatic processes. Figure 1 presents two sets of FORCs simulated using an interacting macrospin system, with a time-dependent description of the magnetization variation, and for two sweeping rates of the external applied field: on the right using the equilibrium solution as given by the Stoner-Wohlfarth model, while on the left the field is swept without waiting for equilibrium.

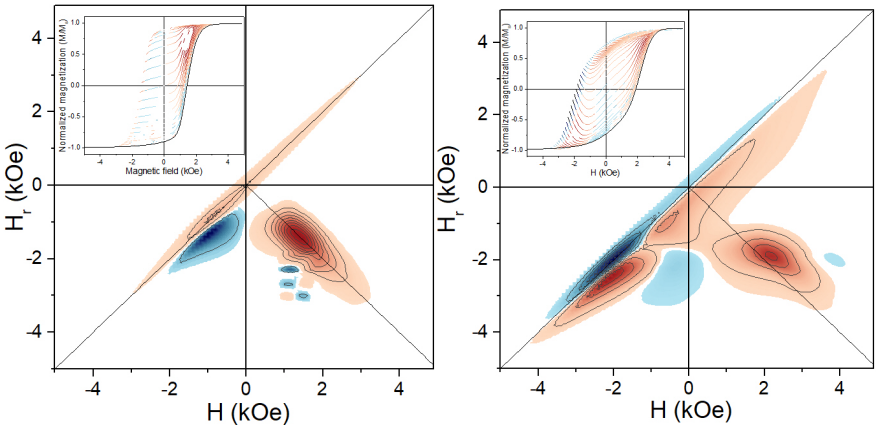

Figure 1. Simulated FORC diagrams for quasistatic (left) and 1 kOe/ns (right) field sweep

[1] A. Stancu, C. Pike, L. Stoleriu, P. Postolache, D. Cimpoesu, Micromagnetic and Preisach analysis of the First Order Reversal Curves (FORC) diagram, Journal of Applied Physics, 93 (2003) 6620-6622.
[2] H. Chiriac, N. Lupu, L. Stoleriu, P. Postolache, A. Stancu, Experimental and micromagnetic first-order reversal curves analysis in NdFeB-based bulk "exchange spring" - type permanent magnets, J. Magn. Magn. Mater., 316 (2007) 177-180.
[3] A. Markou, I. Panagiotopoulos, T. Bakas, P. Postolache, L. Stoleriu, A. Stancu, Magnetization reversal in graded anisotropy Co/Pt multilayers: A first order reversal curve study, Journal of Applied Physics, 112 (2012) 7.
[4] L. Stoleriu, P. Andrei, A. Stancu, First order reversal curves identification procedures for vector models of hysteresis, Journal of Applied Physics, 103 (2008) 3.
[5] L. Stoleriu, I. Bodale, A. Apetrei, A. Stancu, Realistic Reversible Magnetization Component in Preisach-Type Models, IEEE Trans. Magn., 46 (2010) 2341-2344.