Magnetic relaxation effect on FORC-type measurement of 1D chains of Ising-Preisach hysteron systems.

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As the magnetic characterization of materials based on the measurement of the first-order reversal curves (FORC) is really popular for a wide variety of ferromagnetic structures, it becomes more and more necessary to evaluate correctly the dynamic effects on the static scalar FORC diagram [1,2]. Usually, the dynamic effects are visible in the reversal points where in some cases instead of a positive susceptibility, which is to be expected, a negative one is obtained. In fact, the standard analysis of relaxation effect on the FORC diagrams is focused on the accurate evaluation of the singular reversible component but this component is also due to the static reversible magnetization essentially connected to the dispersion of the easy axes of the particles. As the problem is really complex, it is desirable to analyze a simple system that still shows these effects. We have in a number of cases have used arrays of magnetic wires as model samples [3,4] and in this case we chose to study a really simple sample of a 1D chain of wires/dipoles with their easy axes along one line. Each wire has an intrinsic anisotropy and coercivity and a perfect rectangular hysteresis loop (Ising-Preisach hysterons). In such a chain of hysterons the interaction field between the wires has a magnetizing effect and as a result the FORC diagram has a typical shape (called many times as a “boomerang shape” FORC diagram). As we clarify that the source of this shape in a measurement is the presence of chains of particles we also show that in such ensembles, when the inter-particle interactions are really strong a switch of an entire chain can be triggered by one particle. In Fig.1 we show the relaxation processes in the reversal points for the FORC measurement. In this presentation we shall show the results obtained by us in quantifying the effect of interactions on the FORC diagrams measured on chains of wires. We show that these interactions could induce strong distortions on the boomerang-type FORC diagrams and, at the limit, to a complete loss of the ability to detect trough static measurement information concerning the coercivity of individual particles from the chain. This limit could be overcome using full-dynamic FORC measurement.

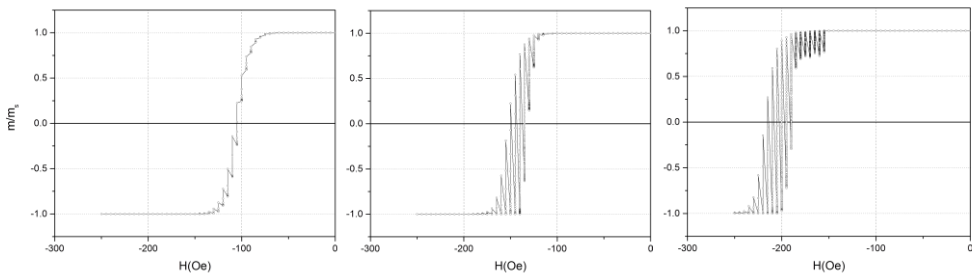

Figure Relaxation processes on the reversal points in the FORC experiment (from left to right the intensity of inter-wire interactions are increasing)

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