Study of Methods for Identification of Preisach Weighting Function for Hysteresis Model in Ferromagnetics From Complete Experimental Data

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Abstract

Preisach model [1] can effectively simulate all the hysteresis phenomena. In ferromagnetic, it uses decreasing and increasing field strengths as two independent variables. They form the Preisach triangle and the model base is the 2D weighting function characterizing investigated material. The direct method of its determination follows from theory [1] and needs extended experiment. The data contain a set of asymmetric minor loops that start at the negative saturation. The decreasing parts of the minor loops are arranged according to the excitation field in the Preisach triangle. They are termed as first order reverse curves, FORC, which is also the name of the method. Then the weighting function is given by two partial derivations of FORCs according to increasing and decreasing field strength. Since the derivation highlights experimental errors, this approach is used rarely, [2] or [3], for instance, and its accuracy is not high. As the weighting function exhibits a sharp maximum, probability functions are often used for its approximation [3] [4], for instance. The results are in an acceptable agreement with the experiment. Theoretically, the direct method should give more exact results, since it uses hysteresis in all the excitation area and, in principle, does not need any optimization. In order to apply numeric derivations, perfect data are necessary. To decrease derivation errors, measurements of FORCs were made by a small step of the field strength. The error reduction used standard methods: running average and low pass filtering. Then the results from derivations are acceptable and do not differ significantly from the approximation approach. A careful data inspection revealed that main problem is in a low accuracy of magnetic measurements. The non-standard methods of the magnetic errors reduction are the main subject of the paper.

References

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