Characterization and modelling of temperature influence on global magnetic properties

Anh Tuan Bui, Noël Burais, Laurent Morel, Fabien Sixdenier, Younes Zitouni

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A.T. Bui, N. Burais, L. Morel, F. Sixdenier, Y. Zitouni

Université de Lyon, Université Lyon 1, F69622, FRANCE ;
CNRS UMR5005 AMPERE, 43, Bld du 11 Novembre 1918, Villeurbanne, F69622

Nowadays, more and more electrical devices are working with high stresses (mechanical, thermal, electrical, ...). This paper focuses on the thermal stress. The aim of this paper is to first, study the global behaviour of the temperature on standard static magnetic properties. In a second time, we use a Jiles-Atherton model [1,2], in order to reproduce the static hysteresis loops obtained with measure for a large class of magnetic materials samples. For each temperature, the five model parameters are optimized [3]. The model parameters variation is also discussed.

Three kinds of materials have already been tested: FeNi 80/20, MnZn N30 and nanocrystalline materials (VITROPERM 800F). This summary only presents some results with the FeNi 80/20 sample. The figure 1 shows a qualitative schematic of the measurement bench. The figure 2 shows the measured and simulated hysteresis loops at 23^0C and 185°C. The table 1 shows the model parameters values for each temperature.

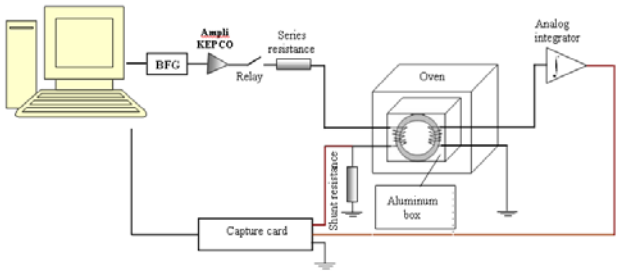

***Fig.1**. Schematic of bench measurement*

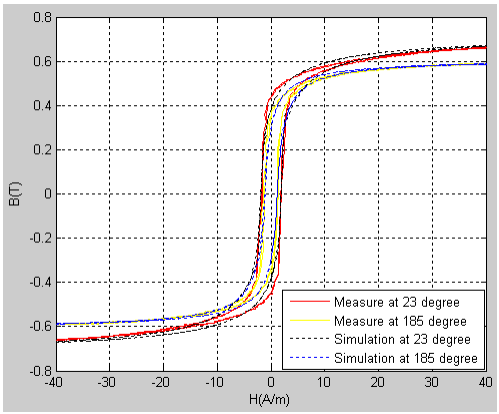

Fig.2. Cycle B (H) measured and simulated FeNi 80/20 at 23^0C and 185^0C . at 0.5Hz

Tab.1.The evolution of five settings to the temperature of the model of Jiles - Atherton

T(°C)	23	37	53	74	93	117	130	163	185
alpha	1,89E-05	1,74E-05	1,49E-05	1,23E-05	1,09E-05	9,51E-06	9,13E-06	8,27E-06	7,81E-06
a	3,74125	3,37791	2,88516	2,35604	2,05547	1,82582	1,77392	1,68901	1,6665
c	0,473881	0,457426	0,424234	0,378371	0,34506	0,315416	0,309557	0,28076	0,29196
k	3,852	3,73463	3,32356	3,07518	2,77851	2,47149	2,32877	1,90071	1,74751
Ms	575964	571468	565051	555814	547256	534316	525521	503107	486020

In the extended paper, the results for the other samples will be presented and discussed. The perspective of this work is to study the influence of electromagnetic properties thermal variations on the performances of electrical devices, and to optimize these devices under high stresses.

[1] D.C. Jiles, D.L. Atherton, J. Magn. and Magn. Mater. 61(1986) 48.

[2] D.C. Jiles, D.L. Atherton, J. Appl. Phys. 55 (6) (1984) 2115.

[3] R. Marion, R. Scorretti, N. Siauve, …, IEEE Trans. Magn. 44(6) (2008). 894-897