QB09

A Superconductor Material Model for Hysteresis Losses Computation

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Superconductivity is a phenomenon for which a material loses any resistance, the currents can thus circulate through its body without any dissipation of energy. The absence of losses in superconductor materialsis real only when it is traversed by a direct current. However, when these materials are subjected to a variation of an external magnetic field, they react so as to protect their interiors from this variation. With this intention, the shielding currents are generated at their periphery. Because of the absence of dissipative phenomena, thesecurrents are established in a permanent way [1]. In this case, the losses occur by Joule effect in superconductor materials.

One model has been applied to the computation of the losses in the superconductor materials [2]. In this work, we have used it for calculating the losses in an infinitely long superconducting line plunged in a uniform field varying periodically in time. In the first step, we have calculated the instantaneous losses in the superconducting linefor the various shapes of the applied magnetic field (sinusoidal, triangular) which is applied parallel to the transverse plan of the line. We have also studied the influence of the amplitude of the applied magnetic field to the instantaneous losses. In the second step, we have calculatedthe average losses by using two various methods. The first method, starting from the instantaneous losses, we have found a standard formula to determine an average loss. The second method, a formula to determine an average loss has been defined by using the surface of the hysteresis loop [3]. This is the reason why they are called hysteresis losses even though their origin is plain Joule effect.

Several numerical results confirm that these two methods give almost the same values of the average losses. Fig.1 shows that the use of this model leads to the values of the hysteresis losses independent from the temporal shape of the applied magnetic induction. Even if the values of the average losses are the same, the maximum values of the instantaneous losses are not the same because of a constant part of the instantaneous losses in the case of the triangular magnetic induction. In fact, when the superconducting line is saturated by the shielding currents, the electric field in the case of the triangular excitation is independent of time, where from the invariance of the losses. Moreover, we can in particular obtain the quantities such as the current density or the magnetization in order to know the phenomenon ofsuperconductivity in superconductor materials.

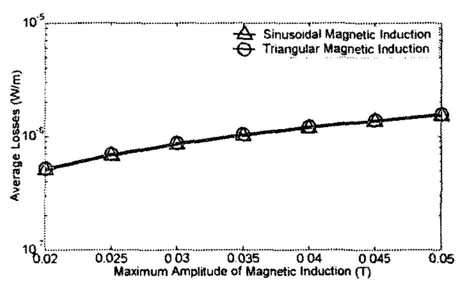

Fig.1. Hysteresis losses in superconducting line.

REFERENCES

[1] T. Satiramatekul, F. Bouillault, A. Devred, and L. Bottura, IEEE Trans. Appl. Supercond., **15**, 2 (2005).
[2] M. Maslouh, F. Bouillault, A. Bossavit, and J.C. Vérité, IEEE Trans. Appl. Supercond., 7, 3 (1997).
[3] T. Satiramatekul, F. Bouillault, and M. Maslouh, Proc. 2nd Int. Symp. on Communications and Information Technologies (2002).

QC01

Analogy of the Domain Switching Between Ferroelectric/Ferromagnetic Materials and Wlc Model

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Analogy between the worm like chain based molecular motion equations and chevron structures of ferroelectric and ferromagnetic materials is presented. Several approaches based on WLC theory have already been made [1-3], and the dimensionless parameteris established to describe the dynamic process. On the other hand, based on Landau-Ginzburg principle, the Fisher-Kolmogrov equation for the Smectic-C chevron ferroelectric structures, as well as the ferromagnetic domains walls, can be obtained as a diffusive equation with cubic nonlinear terms as driving source during the domain switching process. Therefore, it is possible to derive the similar form through the worm like chain model of bio-molecular stringsto the ferroelectric/ferromagnetic materials. The similar form of the Hamiltonian between [3] and [4], encourage us to suggest that it is possible to explore the switching process of the ferroelectric materials and the transients of the ferromagnetic domains through the WLC based theory. The study of the transient on the order parameter of bio-molecular string through the chevron numbers and the comparison between the two models are the key points to explain the three parameters model [5] for the ferroelectric materials, as well as to apply it for the ferromagnetic components.

REFERENCES

[1] Y. Kafri1, D. Mukamel1 and L. Peliti2, Melting and unzipping of DNA, Euro. Phys. J. B 27, p.135, (2002)
[2] J.F. Legal et al, Structural Transitions of a Twisted and Stretched DNA Molecule, Physical Review Letter, Vol.83, No.5, p.1066, (1999)
[3] Wada, Murayama and Sano, Model of Elastic Responses of Single DNA Molecules in Collapsing Transition, Physical Review E 66, p.2002, (2002)
[4] A.N. Shalaginov et al., Dynamics of Chevron Structure Formation, Physical Review E, Vol.58, No.6, pp.7455, (1998)
[5] S.M. Said and S.J. Elston, Modeling of Switching in Surface Stabilized Ferroelectric Liquid Crystal Cells Using a Three Variable Model in One Dimension, Journal of Liquid Crystal, Vol.28, No.4, P.561, (2001)
[6] S.Kralj and T.J.SLuckin, Landau-de Gennes theory of the Chevron Structure in a Smectic-A Liquid Crystal, Phys. Rev. E 50, 2940 - 2951 (1994)