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On the equivalent circuit approximation of magnetoimpedance in amorphous wires

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Abstract

The magnetoimpedance response of CoFeBSi wires was measured at frequencies equal, below and above the relaxation frequency. We show that the behavior of the real and imaginary parts of inductance, as a function of the current amplitude is clearly consistent with modeling of the wire response by means of a parallel *RL* equivalent circuit. © 1998 Elsevier Science B.V.

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1. Introduction

Magnetoimpedance (MI) consists in the variations of the impedance response of a ferromagnetic material (submitted to an ac current of small amplitude), when a dc magnetic field is applied. This extremely sensitive response leads to original applications on magnetic field sensors technology.

MI can be fully explained by classical electromagnetism. Recent results has shown [1,2] that ac current flowing through the material produces a circumferential or perimetral (depending of the cross section of the sample) ac magnetic field which interacts with domains and domain walls. This coupling results in an additional contribution to the total impedance of the sample.

When a dc magnetic field is applied, it leads to a damping of the domain wall movement; if it is large enough to saturate the sample, only rotational magnetization processes remain and the inductive coupling decreases significantly. In the case of samples with small cross section, the combination of high frequencies and small resistivity results in a limited penetration of the magnetic field, and therefore in an additional impedance contribution associated with eddy currents.

CoFeBSi amorphous wires with very low and negative magnetostriction exhibits a strong MI effect. This is related with their magnetic structure, which can be described [3] as formed by two main parts: an inner core, with domains oriented close [4]

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