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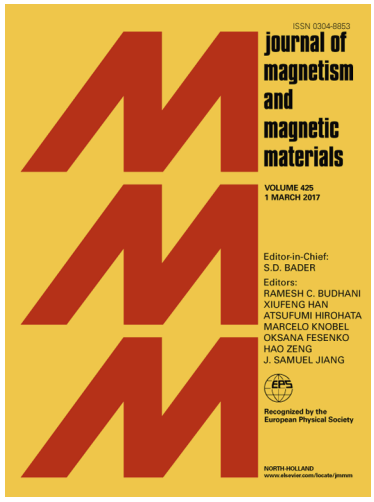

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ACCEPTED MANUSCRIPT

Dimensionless quantities of hysteresis loops

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Abstract

A method of dimensionless quantities for the analysis of hysteresis phenomena is proposed. Dimensionless hysteresis quantities of zero, first, second and third orders are introduced. Analytic expressions are obtained for dimensionless hysteresis quantities in a weak magnetic field. In the Rayleigh region, the order of dimensionless hysteresis quantities coincides with the exponent of the power function that relates these quantities with a hysteresis factor κ_r. It is shown that the scaling in the Rayleigh region extends over the entire region of the magnetic field in which permeability increases. Analytical expressions for the hysteresis losses and permeability are obtained, which are confirmed experimentally.

Key words: dimensionless quantity; hysteresis loop; Rayleigh law; soft magnetic alloy; nanocrystalline

1. Introduction

Hysteresis manifests itself in the ambiguity of the physical quantities characterizing the state of the materia, under cyclic change of some external factors. The cause of hysteresis is associated with the existence in the materia of metastable states and irreversible transition

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