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Some progress concerning the use of magnetic barkhausen noise for magnetic materials characterization

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The Magnetic Barkhausen Noise (MBN) results from the discontinuous motion of magnetic domain walls in magnetic materials under the effect of a variable magnetic field. The MBN signal contains information of several materials features. It has been shown that the MBN is sensible to changes in steel properties such as grain size, carbon content and plastic deformation. Also, the MBN allows detecting the presence of applied or residual stress. Recently, was demonstrated that the MBN signal also contains information about the magnetos-crystalline anisotropy energy of the material. This fact represents an important step in the consolidation of the MBN as a method for magnetic material characterization. The study of the correlation between the MBN and the magneto-crystalline anisotropy energy was possible due to the analysis of the MBN signal by time-bands (or applied field-bands). The time-band method also allows indentifying the presence of magnetization stages using the MBN raw signal. However, although the MBN presents a high potential as a method for extracting different material characteristics, it is worth noting that some of these features vary simultaneously, which make difficult to establish correlations between a specific feature of the material and the MBN parameters. In order to solve this problem several approaches have been proposed, most of them concerning the use of pattern recognition and artificial intelligence algorithms. In particular, it have been demonstrated that it is possible to separated the influence of carbon content and plastic deformation on MBN signal using Feature Extraction algorithms and Self-Organizing Maps artificial networks. These algorithms have proven to be successful for separating the influence of two simultaneously varying materials properties on MBN. Additionally, to the aforementioned progress, the comprehension of how to obtain material features using MBN have been also improved, recently, with new models for the simulation of domain wall dynamics using an assembly of micro-mesoscopic model and Maxwell equation solved using Finite Difference method and computed using parallel programming methods.

Biography

Jose Alberto Perez Benitez has completed his PhD at the age of 33 years from University of Oriente in Cuba and postdoctoral studies from University of Sao Paulo and University of Aveiro. He is professor of postgraduation of Electronic Engineering at the Instituto Politécnico Nacional in Mexico. He has published more than 30 papers in reputed journals in the area of electromagnetic nondestructive methods and machine learning.

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