A novel insight into the concept of the Bertotti's model of separation of total energy losses in soft magnetic materials

P. Kollár,[1] Z. Birčáková,[2] D. Olekšáková,[3] J. Füzer,[1] R. Bureš,[2] and M. Fáberová[2]

[1]*Institute of Physics, Faculty of Science, Pavol Jozef Šafárik University in Košice, Park Angelinum 9, 04154 Košice, Slovakia*
[2]*Institute of Materials Research, Slovak Academy of Sciences, Watsonova 47, 04001 Košice, Slovakia*
[3]*Institute of Process Engineering, Faculty of Manufacturing Technologies, Technical University of Košice, Bayerova 1, 08001 Prešov, Slovakia*

Soft magnetic materials (SMMs) represent a significant class of magnetic materials with a great importance mainly in energy applications. Therefore, the evaluation of energy dissipation during their operation is a key characteristic. SMMs comprise a wide range of material subclasses, differing in their structure or chemical composition. Besides that, they can be divided also according to the dimensions of the cross-section area, where eddy currents are induced by a time change of magnetic flux at AC magnetization – from the largest - bulk cores downwards to e.g. laminated sheets, ribbons, powder particle compacts or composite materials (with micro- to nano-sized particles). The most often used and the widely accepted model for the analysis and prediction of the total energy losses in SMMs is the one considering three main loss components [1] – the hysteresis (DC) losses, the classical eddy current losses and the anomalous (excess) losses, where the latter two constitute the dynamic (AC) losses. The induced eddy currents are responsible for energy dissipation during magnetization reversal generally. In the presented work the Bertotti's model of energy loss separation was analyzed by a novel approach, considering the eddy currents in SMMs in relation to the domain wall movability. Some weak points were found in the concept of this widely accepted model, which were revised and the final relation for the anomalous losses was derived. The relation was experimentally verified on various selected SMMs.

References:

[1] G. Bertotti, General properties of power losses in soft ferromagnetic materials, IEEE Trans. Magn., vol. 24, pp. 621-630, 1988.

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