Influence of preparation parameters on the magnetic properties of soft magnetic materials

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A novel processing approach for iron-based soft magnetic composites (SMCs) is introduced, emphasizing the effect of mechanical surface modification of powder particles on their structural and magnetic characteristics. FeNiMo (supermalloy) powders were subjected to mechanical milling, followed by controlled surface milling, application of an inorganic insulating coating, and subsequent compaction into ring-shaped cores. The magnetic behaviour was assessed through hysteresis loop characterization, coercivity evaluation, and frequency-dependent core loss analysis. The findings indicate that mechanical surface treatment enhances the uniformity and integrity of the insulating layer, resulting in reduced coercivity and decreased magnetic losses, especially at elevated frequencies. This preparation route offers a promising strategy for the development of high-performance SMC materials intended for advanced electromagnetic applications. Overall, the experimental results demonstrate a clear relationship between powder surface morphology, coating homogeneity, and magnetic performance. Smoother particle surfaces favor the formation of a more uniform and continuous insulating layer, which reduces domain wall pinning, lowers coercivity, and effectively suppresses eddy-current losses. Surface-treated soft magnetic composites therefore exhibit narrower hysteresis loops and improved magnetic behaviour compared to untreated materials.

References:

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This work was funded by Scientific Grant Agency of Ministry of Education of Slovak Republic and Slovak Academy of Science grant numbers VEGA 1/0403/23 and VEGA 1/0016/24. This work was also realized by the Slovak Research and Development Agency under contracts No. APVV-21-0228.