Decomposition of Energy Losses in Iron-Based Compacted Powder Materials

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Abstract. Soft magnetic compacted powder materials are used in a wide range of electromagnetic applications, such as electric motors, magnetic circuits in valves, cores for inductors in computers, relays, hard drives, printers, hearing aids, and more. These materials are favored for their ease of magnetization and demagnetization, high permeability, large magnetic saturation induction, low coercivity, and minimal core losses. Additionally, they offer high application potential due to their isotropic 3D behavior, mechanical stability, low production costs, and the ability to be recycled in an environmentally friendly manner.
This study provides a detailed examination of energy loss separation for both DC and AC low-frequency magnetic fields in Fe-based compacted powders. We analyzed the magnetic losses of soft magnetic materials composed of iron particles ranging in size from 125 μm to 300 μm, based on the theories of Bertotti and Landgraf. The surfaces of the iron particles were mechanically polished. Ring-shaped compacts were fabricated using high-pressure compaction. The analysis of total energy losses demonstrated that the material with mechanically smoothed powder particle surfaces exhibited the best magnetic properties.
Special emphasis was placed on the mechanical surface treatment of powder particles, as well as the coating and pressing processes, all of which play a crucial role in determining the final properties of the materials. Optimizing these processes is expected to significantly reduce energy losses, enhance magnetic efficiency, and improve the mechanical stability of the materials [1].

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[1]. Denisa Olekšáková, Peter Kollár, Miloš Jakubčin, Ján Füzer, Martin Tkáč, Peter Slovenský, Radovan Bureš, Mária Fáberová, Energy loss separation in NiFeMo compacts with smoothed powders according to Landgraf's and Bertotti's theories, Journal of Material Science (2021) 56: 12835-12844, https://doi.org/10.1007/s10853-021-06090-y