Influence of different milling parameters on structural and soft magnetic properties of Fe/SiO_2 composites

T. Rudeichuk,[1] D. Olekšáková,[1] W. Matysiak,[2] P. Kollár,[3] and D. Garbiec[4]

[1]*Institute of Manufacturing Management,*
Faculty of Manufacturing Technologies,
Technical University of Košice, Bayerova 1, 08001 Prešov, Slovakia
[2]*Institute of Materials Technology,*
Faculty of Mechanical Engineering,
Poznan University of Technology,
3 Piotrowo St., 60-965 Poznan, Poland
[3]*Institute of Physics, Faculty of Science,*
Pavol Jozef Šafárik University in Košice,
Park Angelinum 9, 04154 Košice, Slovakia
[4]*Łukasiewicz Research Network–Poznań Institute of Technology,*
6 Ewarysta Estkowskiego St., 61-755 Poznan, Poland

Soft magnetic composites (SMCs) are an important type of soft magnetic materials with incredible magnetic properties compared to conventional materials of the same class. Those days SMCs find extensive use in various electromagnetic applications and it's important to provide the best possible magnetic properties with little waste and financial expense. This paper presents structural and magnetic properties of soft magnetic composites made of highly pure iron with SiO_2 coating. The composites were prepared by milling iron granules in a planetary ball mill with different ball to powder ratio (BPR) and innovative surface treatment technic, insulation of prepared ferromagnetic powder into SiO_2 coat and then compacting into ring-shaped samples. The samples made by implying higher BPR showed better coercivity values even with using the same powder fraction. The best coercivity values were shown by sample made with the BPR value 9:1 and an innovative surface treatment technic. The microstructure was studied using scanning electron microscopy (SEM) and X-ray diffraction (XRD), while the magnetic properties were characterized using systems for measuring coercivity and hysteresis such as Koerzimat and Hysterezigraph. The aim of this work is to demonstrate the dependency of the final magnetic properties of the compacted composites on their inner structure and preparation technics. These results could provide valuable information about the optimization of SMCs for various applications.