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Soft magnetic composites: Physical fundamentals and technical applications

The fourth revolution of the industry is powered by a wide range breakthrough, new technology, innovative ideas and creative activities. All these things were naturally born, mostly, by the interdisciplinary science and technology. Soft magnetic composites are the bright example of the different technologies integration to get final commercial products with enhanced properties. In the report we systematized the methods, technologies and structures of this type of heterogeneous materials with soft magnetic properties, pros and cons are discussed. The main mechanisms of magnetization reversal of such structures are reviewed, as well as the effect of inhomogeneities on the main magnetic properties: magnetic induction, permeability, coercive force, and loss. The basic requirements to these materials for practical use in advanced electric machines, electric vehicle motors, electromagnetic micromotors and generators, magnetic memory, and MEMS are analyzed.

We developed the technology of iron powder treatment to create the nanometer coating on the surface of each particle. The final magnetic details are produced by technology of powder metallurgy. Unique specific parameters of a soft magnetic composite material were achieved: magnetic

induction of saturation – 2.1 T, working frequency range - up to 1 MHz, permeability – up to 1000, total loss – 8 W/kg, Curie temperature - above 800C. These allow to produce machines with the large number of poles and high frequency of switching, thus improving specific mass and size parameters. LIGA-like MEMS technology was developed to produce hybrid stepper micromotor based on soft magnetic composites.

Speaker Biography

Ioury Timoshkov focused his scientific activities on the development of heterogeneous materials to improve mechanical and physical properties. In particular, his experience spans technology solutions of magnetic materials and their future applications such as advanced electric machines, electric vehicle motors, electromagnetic micromotors and generators, magnetic memory, and MEMS. He earned his PhD in Micro- and Nano- technology from Belarus State University of Informatics and Radioelectronics (Belarus) in 1992. In his thesis work he pioneered application of composite magnetic materials for magnetic heads and hard discs, memory cell. At present he is the author of 5 patents, about 100 publications. He took part in 25 International Conferences, 10 State scientific programs, commercial R&D projects, member of SID and some local scientific societies. He is a technical expert of LG Electronics Company.

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