High magnetic field processing of nanostructured soft magnetic materials

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Energy is becoming increasingly expensive and a major challenge for the society is to minimize energy consumption. One of the issues of this challenge focuses on the industrial processing of energy related materials and the development of their properties.
The objective of this presentation is to evaluate thermo-magnetic processing as a new tool to develop improved soft magnetic properties unattainable through conventional thermo-mechanical processing. This main target is addressed with the study of the effect of magnetic field on three main alloys, Fe-Co, Fe-Ni and FeSiNbBCu in view of improving their functional soft magnetic properties.
In FeCo alloys the non – equilibrium ferrite to austenite phase transformation measured up to 16T is found to be increased by the application of a high magnetic field. Its evolution with the field intensity is explained using a thermodynamic analysis. In both grades, the ferrite phase is found to be stabilized at higher temperature together with a coarse grains microstructure during recrystallization and growth in high field. Soft magnetic properties are also improved by the application of a magnetic field by a field induced Goss texture enhancement.
In the Fe – 80%Ni composition and in the nanocrystalline $Fe_{74.1}Si_{15.7}Nb_{3.1}B_{6.1}Cu_1$ (Nanophy®) cores, the use of high magnetic field during processing (up to 7T) is found to improve the magnetic induced anisotropy and to tailor the hysteresis loop shape.