# SOFT MAGNETIC NANOCRYSTALLINE MATERIALS: INTERGRAIN COUPLING AND SPIN FREEZING

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The reduction of the grain size to the nanometer range may vary drastically the physical properties of materials, including the magnetic behaviour. Typical examples of such systems are Fe–based extremely soft magnetic alloys. The macroscopic magnetic properties of these materials arise from the interplay of the microscopic parameters such as grain, size, intergrain coupling, anisotropy and interface effects. In this work, the static and dynamic properties of nanocrystalline soft magnetic alloys consisting of Fe–nanograins embedded in an amorphous matrix are investigated by means of dc and ac susceptibility, magnetization and hysteresis loop measurements in a wide temperature range. We show that some alloys of this group exhibit particular complex magnetic properties versus temperature. The spin–glass like behavior is observed at low temperatures. Here a remarkable magnetic anisotropy could be induced after cooling the samples though freezing temperature in an external magnetic field. These low temperature features are followed by very soft magnetic behaviour at intermediate temperature range, and finally, a marked magnetic hardening due to decoupling between the nanograins is observed when temperature approaches the Curie temperature of amorphous residual phase. Striking differences in the decoupling behaviour are observed and discussed for the samples with different volume fractions of nanocrystalline particles.

9.7 cm

13.4 cm

**Subject category :**

3. Transition Metals, Alloys and Compounds

**Presentation mode :**
invited

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