Magnetic anisotropy distributions in nanostructured alloys: From fundamentals to applications.

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Magnetic anisotropy is exploited in the design of most magnetic materials of commercial interest. For hard magnetic materials, the effective anisotropy field is an important parameter in the characterization of their properties, as it gives a theoretical upper limit for coercivity. On the other hand, the extremely low coercivity of soft nanocrystalline alloys is being explained by the effective averaging of magnetic anisotropy. Consequently, it is interesting, both from a theoretical as well as a practical point of view, not only to determine the value of the effective magnetic anisotropy, but also the distribution curve of anisotropy values that gives rise to it.

The magnetic anisotropy distribution can be obtained from a second derivative of the demagnetization curve, provided that the easy axes are oriented at right angles to the applied magnetic field. This method has been applied to hard magnetic materials and, more recently, to soft magnetic amorphous and nanocrystalline alloys. These latter results, where the evolution of the magnetic anisotropy distribution during nanocrystallization of the alloys is analyzed, are in good agreement with the theoretical predictions of the random anisotropy model extended to multiphase systems.

In this talk we will present the procedure for obtaining magnetic anisotropy distribution curves and give some examples of its application to nanocrystalline alloys. We will consider the different parameters which can affect the reliability of the results, like measuring temperature, distribution of easy axis orientations and interactions between phases. Finally, we will correlate experimental giant magnetoimpedance (GMI) results and these distribution curves.