Preface

Magnetic materials constitute today, from the standpoint of the size of their world market and in narrow concurrence with the semiconducting materials, one of the major groups of functional materials. They are involved in a broad range of different technologies going from the electromechanical ones to those related to the information recording. For a given set of phases, present in a particular material and characterized by particular values of saturation magnetization, order temperature and magnetocrystalline anisotropies, the coercivity and remanence depend on many different extrinsic parameters which include from the phase morphology (crystallites size and shape) to the distribution of defects present in them, and, particularly, the characteristics of the intergranular and interphase couplings. The basic consequences of this are the possibility of optimizing and, in some cases, tailoring the properties of a material for a particular application and the fact that, during the last century, most of the research efforts in the field were concentrated on the control of the micro and nanostructures of a relatively reduced set of relevant phases.

The introduction in the technologically relevant magnetic materials of structural correlation lengths of the order of the nm has several important consequences. First, and in the particular case of the nanoparticulate and the nanocrystalline materials, it results on a significant increase of the surface (grain boundary)-to-(particle/grain) volume atomic ratio. Since the moments present at the surfaces and grain boundaries are characterized by a co-ordination different from that corresponding to the bulk materials, the local values at these regions of the magnetization, order temperature, exchange constant and anisotropy can be significantly different from those corresponding to bulk-like regions and largely influence and even rule the global behaviour of the system. Second, the reduction of the crystallite size crucially influences, through the reduction of the absolute number of defects present inside the structurally coherent regions, the global value of defect sensitive properties as, very relevantly, the coercivity. Finally, and most importantly, the nanostructuration brings about the problem of the interphase coupling at length scales comparable with the magnetic correlation lengths.

This book on Nanomagnetism tries to be a forum of discussion of these relevant aspects, i.e.: the exchange and dipolar correlation lengths, giving the width of a domain wall in a bulk and planar uniaxial systems, respectively. Since the coupling is largely ruled by the characteristics of the exchange interactions at the grain boundaries, and since, for the time being, the control of those properties could only be achieved heuristically, it is not exaggerated to state that the main goal of the present book will concern on the magnetic properties of nanostructured materials to achieve a better control of the magnetic properties of the intergranular regions.

Consequently, this book should be a point of reference for students of post-grade as well as researchers of nanomaterials and working in excitating technological fields as electronics, computational or medicine, among others.

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