ABOUT THE EXCHANGE-BIAS FEATURE IN MAGNETICALLY CONTRASTED OXIDE-BASED NANOCONSOLIDATES

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The combination of a ferro-, ferrimagnetic (F) with an antiferromagnetic (AF) material can lead to a spin exchange coupling known as “exchange bias” EB. This phenomenon is characterized by an asymmetric hysteresis loop and an enhanced coercive field [1]. To be most effective, this phenomenon requires nanostructures with maximum interface contact. For this reason, it is mainly focused on multilayers and nanoparticles (NPs) where the interface between the F and AF phases is easier to control. As a result, it is particularly active in the technological fields involving thin films and colloids, such as those of magnetic recording heads [2], magnetoresistive random access memories (MRRAM) [3], magnetic sensors [4] and high storage capacity magnetic recording media [5], for the former, and those of magnetic hyperthermia therapeutic fluids [6], for the later. Even so, it is hardly considered for applications involving bulk solids, regarding the technical difficulty of their processing. The emergence of Spark Plasma Sintering (SPS) technique has propelled a renewed interest on hetero-nanostructured consolidates, opening the way to the production of E-biased solids. Indeed, SPS operates at moderate temperatures for short period of times, favoring ultrafine grained and highly dense microstructures [7]. Under these conditions, the limits highlighted could be overcome and as pioneering research, we combined soft chemistry, the polyol process, and SPS in order to prepare such solids, starting from E-biased core-shell NPs or a mixture of F and AF NPs, and finding the best sintering conditions in order to promote large and highly crystallized interfaces. As a case study, we focused on F spinel ferrites interfaced with AF rock-salt transition metal oxides, which exhibit interesting magnetic properties for the design of such solids and their characterization [8] within relatively easy-to-achieve operating conditions, allowing an easy experimental evidence of EB at low temperature.

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