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Customization of Thermal Expansion in FeCo Nanowires

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There is a great need to control the thermal expansion (TE) in the technology industry, where devices can be degraded due to differences in TE. Negative thermal expansion (NTE) arises as a key to customize the TE. [1] Recent advances at the nanoscale, more precisely nanomaterials with 1D architecture have revealed that TE is a size-dependent feature. [2] FeCo alloys thin films have been proved to possess both a giant and negative magnetostriction [3] being also are considered invar alloy's [4] owning almost zero TE in the transition from ferromagnetic to paramagnetic [5]. Besides, FeCo alloys have diversified applications such as magnetic recording and catalysts [6], motivating the customization of TE in FeCo alloys at nanoscale.
In this work, we synthesized nanowires (NWs) of FexCox-1 (x=10,50,90) [7] through DC electrodeposition using anodic nanoporous alumina as templates [8]. The latter was produced by aluminium anodization which is a highly efficient method to grow self-organized nanoporous in hexagonal distribution with various dimensions [8]. Three solutions with different ionic concentrations of Fe and Co were prepared to obtain the different stoichiometries [7]. An accurate study of electrodeposition potential was performed for each solution to obtain the most efficient and highest deposition rate. This was possible by adapting the Faraday law of electrolysis to a self-ordered hexagonal nanoporous substrate. The morphological and structural characterization of the obtained FexCox-1 NWs with different diameters was carried out by scanning electron microscopy (SEM) and X-ray diffractometry (XRD), respectively.
Ongoing work includes XRD measurements as a function of temperature to determinate the TE coefficient of the FexCox-1 NWs with different diameters. We intend to model the customization of TE of these NWs by varying the key parameters of stoichiometry, diameter and length.

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