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Towards the magnetic properties of Fe nanowires for biomedical applications

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Recently, a considerable effort has been placed on the study of 1D nanostructures, such as nanowires, nanopillars and nanorods, owing to their biomedical applications [1]
Among several methods that can be employed in the synthesis of NWs, template-assisted electrodeposition in porous anodic aluminum oxide (AAO) has been considered a convenient technique, because of its simplicity and easiness of controlling the size and shape of the nanostructures without requiring expensive equipment or time-consuming processes. AAO templates allow the fabrication of large area and highly ordered nanostructures. In particular, the magnetic behavior of ferromagnetic NW arrays grown in AAO templates has been extensively investigated during the last two decades [2]. Multilayered NWs, built by several magnetic and nonmagnetic materials, have been study by several authors because of the possibility to restraint the magnetic interactions and tune the magnetic anisotropic effects by changing the deposited material and/or the segment lengths [3], having been demonstrated highly tuneable and suitable to the required application. However, with the aim of employing such structures in biomedical applications, and since some metals possess associated toxicity levels, such as Co and Ni, the need to fabricate completely biocompatible segmented NWs have arisen. In this framework, few studies have been reported yet.
Therefore, the main purpose of the present work is the synthesis and characterization of Fe/Cu multi-segmented NWs grown by electrodeposition in AAO templates. We have investigated the magnetic behavior of multi-segmented Fe/Cu NWs by varying the number of bilayers from 1 to 20, for fixed Fe and Cu lengths, or changing the magnetic layer thickness for two Cu layer lengths (60 and 120 nm). In this latter case, the lengths of the Cu segments have been accurately chosen to be ≥ 60 nm, corresponding to a situation where the magnetostatic coupling between nanosegments can be neglected. In addition, the Fe lengths have been substantially varied (from 20 to 345 nm) to comprehend the magnetic properties of the nanostructures when increasing their related aspect-ratio. Preliminary studies regarding the cell viability and uptake assays of these Fe NWs were performed in a human breast cancer cell line (MDA-MB 231).

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