Synthesis and magnetic properties of cobalt-iron/cobalt-ferrite soft/hard magnetic core/shell nanowires

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Abstract

A straightforward method for the synthesis of $CoFe_{2.7}/CoFe_2O_4$ core/shell nanowires is described. The proposed method starts with a conventional pulsed electrodeposition procedure on alumina nanoporous template. The obtained $CoFe_{2.7}$ nanowires are released from the template and allowed to oxidize at room conditions over several weeks. The effects of partial oxidation on the structural and magnetic properties were studied by x-ray spectrometry, magnetometry, and scanning and transmission electron microscopy. The results indicate that the final nanowires are composed of 5 nm iron-cobalt alloy nanoparticles. Releasing the nanowires at room conditions promoted surface oxidation of the nanoparticles and created a $CoFe_2O_4$ shell spinel-like structure. The shell avoids internal oxidation and promotes the formation of bi-magnetic soft/hard magnetic core/shell nanowires. The magnetic properties of both the initial single-phase $CoFe_{2.7}$ nanowires and the final core/shell nanowires, reveal that the changes in the properties from the array are due to the oxidation more than effects associated with released processes (disorder and agglomeration).

Keywords

bi-magnetic materials, CoFe alloys, core/shell nanostructures, nanowires, oxidation, soft/hard magnetic structures.