Three-dimensional magnetic nanostructures grown by Focused Electron Beam Induced deposition

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Abstract
Focused Electron Beam Induced deposition (FEBID) can be assimilated to a local Chemical Vapour Deposition (CVD) technique where the dissociation energy to break the precursor molecules is not provided thermally but through a focused electron beam [1]. By using Co-based and Fe-based metallorganic precursors, a large variety of two-dimensional magnetic nanostructures have been created by FEBID, as recently reviewed by De Teresa and Fernández-Pacheco [2]. We have recently succeeded in the growth of three-dimensional cobalt nanowires by FEBID, which show good magnetic response as probed by magneto-optical Kerr effect [3]. In the present contribution, we will report the subsequent effort towards the understanding of the growth strategies that permit to fabricate three-dimensional cobalt nanowires with high cobalt content and aspect ratio. Our work demonstrate that this can be achieved using a pulsed deposition technique and the appropriate precursor flux, electron dwell time and refresh time.

References
[1] Book "Nanofabrication using focused ion and electron beams: principles and applications (2012), Editors: P. E. Russell, I. Utke, S. Moshkalev, Oxford University Press
[2] J.M. De Teresa and A. Fernández-Pacheco, Appl. Phys. A **117** (2014) 1645
[3] A. Fernández-Pacheco et al., Sci. Rep. **3** (2013) 1492
[4] L. Serrano-Ramón et al., manuscript in preparation

Figures

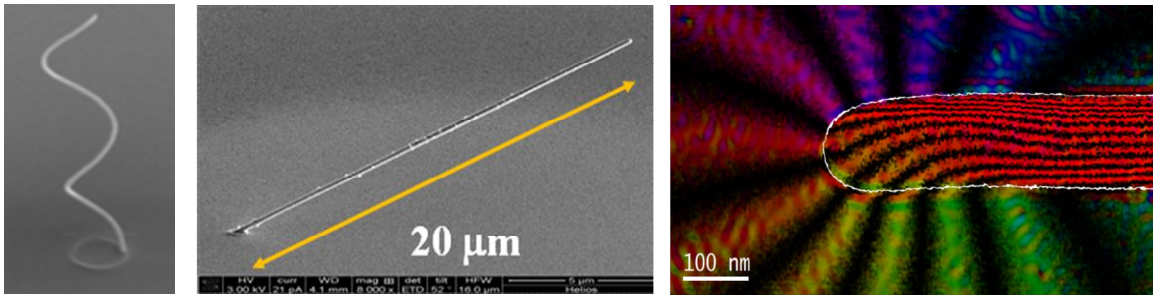

Figure caption. *Left*. Two-loop three-dimensional cobalt nanowire grown by FEBID. *Middle*: High aspect-ratio three-dimensional cobalt nanowire grown by FEBID. *Right*: Magnetic signal obtained in the electron holography experiments performed in one of the cobalt nanowires grown by FEBID.