Focused electron beam induced deposition of magnetic nanostructures

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Nanopatterning strategies of magnetic materials normally rely on standard techniques such as electron-beam lithography using electron-sensitive resists. Focused electron beam induced deposition (FEBID) is currently being investigated as an alternative single-step route to produce functional magnetic nanostructures. Thus, Co-based [1] and Fe-based [2] precursors have been recently investigated for the growth of magnetic nanostructures by FEBID. In the present contribution, I will give an overview of the existing literature on magnetic nanostructures by FEBID and I will focus on the growth of Co nanostructures by FEBID using Co$_2$(CO)$_8$ as precursor gas. The Co content in the nanostructures can reach 95% [3]. Magnetotransport experiments indicate that full metallic behaviour is displayed with relatively low residual resistivity and standard anisotropic magnetoresistance (0.8%) [3]. The coercive field of nanowires with changing aspect ratio has been determined in nanowires with width down to 150 nm by means of Magneto-optical Kerr Effect [4] and the magnetization reversal has been imaged by means of Magnetic Force Microscopy, Scanning Transmission X-ray Microscopy as well as Lorentz Microscopy experiments. Nano-Hall probes have been grown with remarkable minimum detectable magnetic flux. Noticeably, it has been found that the domain-wall propagation field is lower than the domain-wall nucleation field in L-shaped nanowires, with potential applications in magnetic logic, sensing and storage [5]. The spin polarization of these Co nanodeposits has been determined through Andreev-Reflection experiments in ferromagnetic-superconducting nanocontacts and amounts to 35% [6]. Recent results obtained in Fe-based nanostructures by FEBID using Fe$_2$(CO)$_9$ precursor will be also presented [7].
