Magnetic anisotropy in electroplated Co and CoFe nanowire arrays

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Magnetic nanostrips are recently becoming the subject of intense research due to their potential as magnetic memory and sensor devices [1]. Alternatively, cylindrical magnetic nanowires prepared by electrochemical route offer an interesting alternative since they are less-expensively fabricated and constitute ideal systems for fundamental magnetic studies and derived technological applications [2]. FeNi-base nanowires have been intensively studied and their magnetization process is mainly determined by the shape anisotropy owing to the large length to diameter aspect ratio. Magnetic hardness can be nevertheless tailored in Co-base nanowires since their magnetocrsytalline anisotropy modifies significantly the magnetization easy axis and the reversal mechanism [2]. In this work, we firstly show most recent results on the correlation between crystal phase of Co nanowires (i.e., hcp hexagonal or fcc cubic symmetries) and magnetization reversal. Depending on the nanowires length diameter and on pH during electroplating, different crystalline phases are observed and the magnetization easy axis is accordingly modified. Coercivity reaches values of around 0.2 T. As for CoFe-base nanowires, they are being proposed in novel generation of rare-earth free permanent magnets exploiting their high Curie temperature and saturation magnetization, and relatively strong magnetocrystalline and inherent large shape anisotropies. Systematic studies have been performed on the dependence of coercivity on length and diameter of nanowires, and on thermal treatments. Optimized results are obtained for reduced diameter (down to 20 nm) and after annealing at around 550^{o}C. Enhanced anisotropy and coercivity (about 0.5 T) are observed while bcc structure with ¡110¿ orientation remains even after thermal treatments. The angular dependence of magnetic behavior has been also investigated revealing the role of the effective magnetic anisotropy in the coercivity mechanism.

[1] X. Kou et al., Adv. Mater, 23,1393 (2011); J. Bran, Materials Today (Aug.2012) [2] L.G. Vivas et al., Appl. Phys. Lett. 100, 252405 (2012)