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# Preparation and characterization of low-carbon iron ultra thin films produced by Pulsed Laser Deposition

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**Abstract** –low carbon-iron ultra thin films have been synthesized by Pulsed Laser Deposition (PLD), high quality thin films was obtained in the range of 60 nanometers of thickness, the films show a ferromagnetic behavior at room temperature and 20 K and the interstitial carbon atoms generates a change in the coercive field, that changes are from 15 mT to 29 mT for the films with a 2 at. percent of carbon.

Structural, mechanical and magnetic properties of carbon-iron ultra thin films varying the Fe-C ratio prepared by Pulsed Laser Deposition (PLD) are here reported. Ultra thin films were grown with an Nd:YAG laser of λ=1064 nm on a substrate of $Si/Si_3N_4$ with a crystallographic orientation (400)/(101) using elemental mixing of Fe varying the C content (0, 2, 4, 6 and 8 at %). The prepared thin films were characterized by AFM on the surface and cross section revealing high quality ultra thin films with an average thickness and roughness of 60 nm and 3 nm, respectively. No traces of oxidation were found from the chemical analysis by Energy Dispersion Spectroscopy during the analysis by Scanning Electron Microscopy in any of the films. The typical bcc structure of Fe-C materials but texturized in a (110) orientation was identified by Grazing Incidence X-Ray Diffraction (GIXRD). A growth of the lattice parameter from (0.2866 ± 0.0001) to (0.2874 ± 0.0001) nm respectively, was observed for Fe-C 2 % at C prepared film respective to pure iron, which is the evidence of the formation of interstitial solid solution of carbon atoms introduced to the iron structure. XRD and GIXRD analysis showed the existence of residual stresses on the film/substrate interface. The films showed ferromagnetic behaviour as measured by Magneto Optical Kerr Effect (MOKE) at room temperature having an average of the coercive magnetic field of $\mu_o H_c$ = 15 mT. The sample prepared with the 2 at %C showed remarkable increment of the coercive field reaching values of $\mu H_c$ = 29 mT. Nanoindentation measurements at penetration loads close to the 10% of the film thickness were carried out for the assessment of the film mechanical properties. No quantitative analyisis was possible due to the indenter tip radius which is above 300 nm. Further work has to be done to characterize an effect of the composition on the mechanical properties of these films.

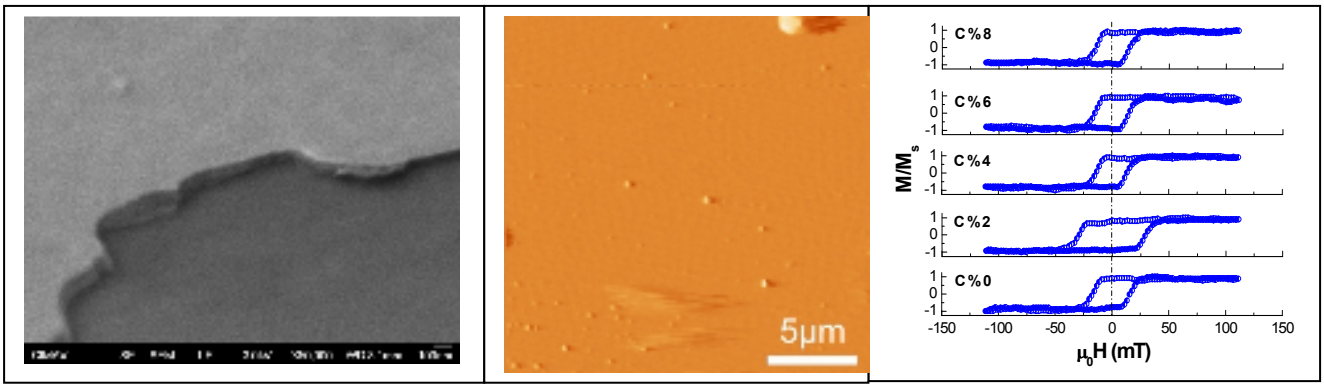


**Figure 1:** SEM image of a Fe-C thin film deposited by PLD (C: 2 % at) (rigth). AFM image show low rougtness

**Figure 2:** hysteresis loops for thin films.