Spintronics, dilute magnetic semiconductors, and semiconducting heterostructures

3 - 1 − Structural, optical and morphological properties of $Ga_{0,72}Mn_{0,28}As$ thin films deposited by magnetron sputtering for spintronic device applications

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In this work GaMnAs alloy materials were deposited on Corning glass 7059 and GaAs (001) substrates by RF magnetron sputtering technique. Concentration of Mn about 0.28 was obtained by Energy dispersive X-ray spectroscopy (EDS). The substrate temperature was changed from 440 C to 520 C and layer thickness between 172 nm and 428 nm were obtained. Characterization by atomic forced microscopy (AFM) and x-ray diffraction (XRD) were performed to determinate the surface morphology and crystal structure, respectively. From transmittance spectral measurements were determined the optical constants: Band gap energy (Eg), absorption coefficient, refraction index (n). A correlation between morphological properties and substrate type was studied too. Diluted magnetic semiconductor such as GaMnAs are considered one of the promising materials for the development of new spin-electronic devices.

3 - 2 − Relation between structural and magnetic properties in (Ti,Fe)O_2 powders obtained by mechanical milling

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In previous works we have found a relationship between magnetism and oxygen vacancies in TiO_2 powders doped with hematite (alpha-Fe_2O_3) by mechanical alloying [1]. Also we found a correspondence between oxygen vacancies and oxidation state of Fe (more Fe^{2+} more oxygen vacancies in the octahedron of coordination of Fe). Then, with the objective to investigate the role of oxygen vacancies and ions Fe^{2+} in the magnetism of diluted magnetic oxides (O-DMS) we doped TiO_2 with Fe by mechanical alloying of TiO_2 with different fractions of FeO (between 2.5 and 10 at. percent) in argon atmosphere. XRD, Mössbauer spectroscopy, X ray absorption spectroscopy (XAS), AC-susceptibility and magnetization measurements were employed in order to characterize the Fe-doped TiO_2 powders. A XAS results showed that Fe ions are incorporated into the rutile phase with oxygen coordination lower than that expected in this phase. The coordination number of oxygen decreases with the increase of Fe^{2+} ions as it was previously found in milled samples of TiO_2 doped with hematite. The RT Mössbauer spectra were reproduced using two paramagnetic interactions, one corresponding to Fe^{2+} (isomer shift 0.87 mms^{-1}) and the other to Fe^{3+} (0.31 mms^{-1}). Magnetometric measurements showed the presence of paramagnetic and ferromagnetic like interactions at room temperature. The relation between relative fraction of Fe^{2+} and the oxygen vacancies with magnetic behaviour will be discussed.

[1] A.M. Mudarra Navarro, V. Bilovol, A.F. Cabrera, C.E. Rodríguez Torres and F.H. Sánchez Physica B 404 (2009) 2838-2840.

3 - 3 − Ferromagnetism diluted in $Zn-$ and Co-doped $CeO_{2-\sigma}$

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This work aims to study a new system that shows diluted magnetic with room-temperature ferromagnetism. It is known that zinc oxide and cerium have diluted magnetic properties and we believe obtaining the $Zn-$ and Co-doped $CeO_{2-\sigma}$ that may open a new line of research in material for application in spin electronic with Tc above room temperature. A proteic sol was prepared by dissolving $Zn(NO_3)_2.6H_2O$, $Co(NO_3)_2.6H_2O$ and $(NH_4)_2Ce(NO_3)_6$ in filtered coconut water with $x = 0.01$, 0.05 and 0.1 to obtain the $Ce_{1-2x}Zn_xCo_xO_{2-\sigma}$. Afterwards, the sol was heated at 100°C for 24 h for gelification and calcined at 600 and 800°C for 1 h. The XRD patterns for both calcination temperatures, were identified using JCPDF #34–0394, which suggests a cubic symmetry belonging to the F_{m-3m} space group characteristic of CeO_2 without Zn or Co oxide phase. Except for $x = 0.1$, that showed spurious phase attributed to Co_3O_4 indicating that the maximum doping into CeO_2 is below 10%. Raman spectrum we observed a peak most pronounced feature for the CeO_2 samples, and it is localized at about 463 cm^{-1} to calcined temperature of 600°C and 467 cm^{-1} to 800°C. This mode ($F2g$) represents a symmetric "breathing" mode of the O atoms around each Ce. Besides peaks at about 250 and 600 cm^{-1} are also associated with CeO_2 due to the presence of defects in the resulting formation of oxygen vacancies. The M versus H (M(H)) at 2 and 300 K showed ferromagnetic behavior for $x = 0.01$, 0.05 and 0.1 for samples calcined at 600 and 800°C. The saturation magnetization (Ms) at room temperature for samples calcined at 600°C, showed values

of the $3.1x10^{-5}$, $6.99x10^{-4}$ and $8.55x10^{-4}$ emu/g for concentrations of $x = 0.01$, 0.05 and 0.1, respectively. However, the samples calcined at $800°C$ happened an increase in saturation magnetization about twice higher for $x = 0.1$ and four times higher for $x = 0.05$ indicating that the increase of crystallinity and the generation of oxygen vacancies (confirmed by Raman spectroscopy), contributing to the ferromagnetism of $Ce_{1-2x}Zn_xCo_xO_{2-\sigma}$. The measures of M versus T were collected under ZFC and FC protocols (M(T)) between 2 and 300 K. The sample with $x = 0.1$ showed the highest value of magnetization ($2x10^{-3}$ emu/g), followed $x = 0.05$ ($1.6x10^{-3}$ emu/g) and $x = 0.01$ ($1x10^{-3}$ emu/g) when calcined at $600°C$. It was observed a increasing of the M(T) with increasing calcination temperature. The Zn- and Co-doped samples showed no irreversibility temperature or blocking temperature and we can infer that Currie temperature (Tc) is above room temperature.

3 - 4 – Saturation Magnetic Moments studies of Mn doped GaAs and GaN doped thin film

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GaAs and GaN thin films doped with Mn were grown by Reactive Sputtering method. We have studied films doped with different concentrations of Mn (0.5 – 18 %) by means of magnetic susceptibility and Electron Spin Resonance (ESR) experiments. A single nearly temperature independent g $\sim$ 2 line is observed for the Mn–doped films. ESR intensity of this line roughly follows the paramagnetic Curie–law measured in the magnetic susceptibility. At low–T, we have observed ferromagnetic loops for $Ga_{1-x}Mn_xN$ (x = 18%) thin films and followed the maximum saturation magnetic moment (M_S) as a function temperature for this film. However, no evidence for a ferromagnetic transition was verified on the ZFC and FC susceptibility curves, in contrast to the ferromagnetic ordering observed in crystalline films for at $T_C \sim 110$ K.

3 - 5 – Rare-earth doping induced exponential depletion the neutral dangling bonds (D^0) density in amorphous Si films

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In this work we study the effect reduction in the density of dangling bonds species D^0 states in a-Si films as function concentration for different Rare-Earth species. The amorphous silicon thin films doped with different concentrations of rare-earth (a-$Si_{1-x}RE_x$, RE = Y^{3+}, Gd^{3+}, Er^{3+}, Lu^{3+}) were prepared by co-sputtering and investigated by Electron Spin Resonance (ESR) and Raman scattering experiments. According to our data the RE-doping reduces the ESR signal intensity of the D^0 states with an exponential dependence on the rare-concentration. Furthermore, the reduction produced by the magnetic rare-earths Gd^{3+} and Er^{3+} is remarkably greater than that caused by Y^{3+} and Lu^{3+} , which led us to suggest an exchange-like coupling between the spin of the magnetic RE´s^{3+} and the spin of silicon neutral dangling bonds.

3 - 6 – Structural and Magnetic Characterization of $Ce_{1-x}TM_xO_2$ Nanoparticles

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In last years the study of the so-called diluted magnetic semiconductors (DMS) has attracted the attention of the scientific community due the strong potential of their application on technological devices [1]. For practical applications, it is very important that DMS samples present magnetic order at room temperature. There are reports in the literature which state that the appearing of the magnetic order is sample dependent, that is, magnetic clusters can be grown inside the semiconductor host depend on the sample preparation and the doping level. On the other hand, the existence of the localized ferromagnetism has been observed via X-ray magnetic circular dichroism [2]. Then, the main challenge is to control the insertion of the magnetic ion inside the semiconductor host. In this work, we have used co-precipitation chemical method to synthesize the $Ce_{1-x}TM_xO_2$ ($0.01 \leq x \leq 0.1$) DMS system at nanometric scale (TM = Fe, Cr). The structural and magnetic properties have been investigated by means of

X-ray diffraction (XRD) and magnetization measurements. Rietveld refinement method is used in the analysis of the XRD pattern. The results show the presence of single crystalline phase with a crystalline structure that is isomorphous to the semiconductor host CeO_2. Particle average sizes ranging between 4 and 7 nm were obtained from the Rietveld refinement results together with the Scherrer formula. This result was confirmed by transmission electronic microscopy images in case of Fe (0.01 in weight) doping sample. DC magnetization measurements performed at room temperature as a function of the field have shown a ferromagnetic behavior for all $Ce_{0.99}TM_{0.01}O_2$ samples (CNPq, FAPITEC).

[1] J.K. Furdyna, J Appl. Phys.(1998) 64, R29.

[2] M. Kobayashi, et al., Phys. Rev. B 72, 201201, 2006.

3 - 7 − Effects of Cr doping on the room temperature ferromagnetism of chemically synthesized $CeO_{2-\delta}$ nanoparticles

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In the last years, many works have been suggested cerium oxide (CeO_2) as a very interesting candidate to develop spintronic devices because its electronic configuration and structural properties are similar to silicon. In this work, we studied the synthesis of $Ce_{1-x}Cr_xO_{2-\delta}$ nanoparticles by the sol−gel method. The samples were prepared by adding $Ce(NO_3)_3.6H_2O$ and $Cr(NO_3).9H_3O$ to de-ionized water to obtain a $2M$ solution with a molar ratio of $x = [Cr]/[Cr] + [Ce]$ with target ratios meant to obtain a systematic variation of x in the $0-0.05$ range. Then, the mixture was polymerized to form the gel at $100°C$ for $24h$. After that, the amorphous composite precursor obtained was calcinated at $400°C$ in air for $1h$ to produce the metal oxide nanoparticles. All samples showed only the cerianite cubic and the peaks of CeO_2 and were identified using JCPD 34−0394. The sizes of the crystallites estimated from the peaks of the XRD patterns are in the range $30-58$ nm. It was observed that all samples showed the Raman vibrational frequency around 468 cm^{-1}, which is the value expected for the vibrational mode of the CeO8. This observation suggests the absence of secondary phase and is in agreement with the findings obtained from XRD. SEM images showed that the surface topography of the $CeO_{2-\delta}$ sample has a porous and loosen structure, while the Cr doped samples exhibit a dense and compact structure. The morphology study by TEM showed that the pure and Cr doped $CeO_{2-\delta}$ particles present average diameter around 35 and 50 nm, respectively. The Cr content in the samples, determined by EDS, was about $x = 0$, 0.018, 0.037, and 0.051, which was consistent with the design of our experiment. The XPS spectra for Cr doped $CeO_{2-\delta}$ samples showed that a mixed oxidation state with Cr^{2+} and Cr^{3+} coexisting. Based on the Gauss fitting, the $Cr2p_{3/2}$ and $2p_{1/2}$ peaks positions were found at 576.1 eV and 587.2 eV respectively. These results exclude the possibility of the Cr cluster formation and indicates that a higher content of Cr^{3+} substitute Ce ions positions in the crystal. The Cr doped $CeO_{2-\delta}$ samples is found to be ferromagnetic. We verified that, at 300 K, samples had weak ferromagnetic behavior, with magnetization saturations of 5×10^{-3} and 3×10^{-2} emu/g for samples with 1% and 5% of Cr, respectively. The coercivity field also increases by six orders of magnitude from 95 Oe(1%Cr) to 101 Oe(5%Cr). The ZFC and FC magnetization curves exhibited the same small slope behavior, indicating a strong paramagnetic contribution. These results indicate that the weak ferromagnetic behavior observed in Cr doped $CeO_{2-\delta}$ nanoparticles are related with the dilute localized magnetic moments presence inside the semiconductor matrix.

3 - 8 − Effect of the thermal treatment in vacuum on Fe- doped SnO_2 powders

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On the last years an enormous activity has been directed to understand the origin of the magnetism in oxide diluted magnetic semiconductors. These kinds of material are produced doping a semiconductor oxide with a transition metal. Most reported models for the observed magnetic behaviour are based on the interaction among magnetic impurities mediated by oxygen or free carriers. Furthermore experimental works have shown that defects, like oxygen vacancies, could lead to ferromagnetism. Since oxygen vacancies concentration can be modified by adequate thermal treatment, in this work we study the influence of the thermal treatment (TT) in vacuum on SnO_2 doped with 10 at. % of Fe. The sample was prepared by mechanical alloying during 5h in air. The TT was carried out in vacuum during two hours at the 773K. It leads to an important change in the structure of the sample. Before TT from the structural point of view the sample is monophase (rutile) with Fe substituting Sn in the lattice of semiconductor. After TT, iron ions migrate from SnO2 lattice and recombine with tin and oxygen forming a new spinel type $Sn_xFe_3-xO_4$ phase. A fit of the diffractogram corresponding to TT sample shows that the 30 % of the intensity corresponds to the spinel type phase. The room temperature Mössbauer

spectrum reveals about 93 % of irons in magnetically ordered state in contrast with the paramagnetic order observed in the non treated sample. Magnetization vs applied magnetic field (M vs. H) curve shows hysteresis loop, typical of soft ferrimagnet. So, we ascribe the magnetic behavior detected after the TT to the formation of the $Sn_xFe_3 - xO_4$ phase.

3 - 9 − Size and doping effect on structural and magnetical properties of $Sn_{1-x}TM_xO_2$ nanoparticles (TM = Fe, Cr, Mn and Ni)

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Diluted magnetic semiconductors (DMS) have attracted many researchers at areas different because its potential in applications at optoelectronic devices, in which one seeks to control both the charge and spin degrees of freedom of the electron [1-4]. In the last years some works have been reported to present ferromagnetic order close to room temperature. Some groups defend the idea of the existence of magnetic clusters, but for others groups this ordering is related to localized impurity magnetic moments induced by indirect exchange (RKKY) interaction mediated through free carriers (either electrons or holes) [2,4]. So, the control in preparation of these materials is extremely important for appearing of both properties. In this sense we have studied the magnetic and structural properties of Mn-doped SnO2 and ZnO for different doping concentrations obtained by coprecipitation method. These samples were prepared such in bulk and nanostructure form. X-ray diffraction results show that all samples present isomorphous phase to the host structure without presence impurities phases for concentrations up to $x = 0.10$. For nanostructured samples, analysis of Rietveld refinement show that particles have average size of 4-25 nm for SnO_2. These results also confirm the presence of high microstrain in the samples with size very small. Magnetization results as function field at room temperature show that the ferromagnetic origin in these samples appears only for doping concentration higher than 0.1. Other result interesting is the dependence on magnetic properties as function of the particles sizes showing the intermediary limit of appearance of weak ferromagnetism in these systems. (FAPITEC-SE, CNPq)

[1] L.W. Yang et al., J. Appl. Physics 99 (2006) 074303.

[2] D.J. Priour and S. Das Sarma, Phys. Rev. Letters 97 (2006) 127201.

[3] D. Karmakar et al., Phys. Rev. B 77 (2008) 245208.

[4] B.D. Yuhas et al., Nano Letters 7 (2007) 905.

3 - 10 − DFT study of the structural, electronic and optical properties of the LiF and $L_{0.75}M_{0.25}F$ (M=Mn, Mg, Ti)

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Structural, electronic, and optical properties of the lithium fluoride LiF, and the doped compounds $Li_{0,75}M_{0,25}F$ (M=Mn, Mg, Ti), are studied using the full-potential linearized augmented plane wave method (FP-LAPW) in the framework of density functional theory (DFT). The exchange-correlation potential is treated by the generalized gradient approximation within the scheme of Perdew, Burke and Ernzerhof (GGA-PBE). The calculated bulk properties, including lattice constants, bulk moduli and their pressure derivatives are in great agreement with the available data for the LiF, data are not available for the $Li_{0,75}X_{0,25}F$. Energy band structures show that the LiF is direct energy band gap insulator material and the doped systems are metallic. Analysis of the density of states and the energy vs. volume graphics, allowed us to understand the effect of the impurities in the LiF structural and electronic behavior. the energy dependent refractive index, reflectivity and the absorption spectrum are calculated for all compounds within the random phase approximation (RPA) using Kohn Sham orbitals. Based on our results we postulate the $Li_{1-x}M_xF$ (with $x < 0.25$) systems as a potential diluted magnetic semiconductors.

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3 - 11 – ELECTRICAL TRANSPORT PROPERTIES OF AgInS2 THIN FILMS PREPARED BY CO-EVAPORATION

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This work presents results regarding the influence of preparation conditions on the electrical transport properties of $AgInSi_2$ (AIS) films, grown by co-evaporation of precursors in a two-stage process. For this, the AIS films were investigated by conductivity and Hall-voltage measurements. This measurements as a function of temperature, carried out in the range between 90K and 600K revealed that the electrical transport in AIS films is affected by two different mechanisms. At temperatures greater than 350K, the conductivity is predominantly affected by hole transport in extended states of the valence band, whereas at temperatures below 250K the conductivity is mainly determined by the variable range hopping (VRH) transport mechanism. These results were correlated with XRD measurements.

3 - 12 – Substrate dependence of the optical and structural properties of GaSb layers

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In this work, we report the optical and structural properties of GaSb layers grown on Si(100) and GaAs (100) substrates by using magnetron sputtering R.F technique in an argon atmosphere. We varied the substrate temperature (300 ^{o}C < Ts < 600 ^{o}C), and the Ar pressure (10^{-3} Torr < P < 10^{-2} Torr) in order to correlates with the microstructure, morphology and vibrational modes of the GaSb layers. We observed an improvement of the structural ordering of the GaSb layer by X-ray diffraction when increasing the growth temperature and decreasing the residual Ar pressure. The optical properties were analyzed from FTIR spectroscopy and micro-Raman spectrum taken at room temperature by using the line 479 nm of an argon laser as excitation source. The results show a strong influence of the growth condition and the substrate orientation on the microstructure and TO and LO vibrational modes associated to GaSb.

3 - 13 – Optical, structural and magnetic characterization of AlN/Mn Multilayers

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The AlN/Mn multilayers were deposited by magnetron sputtering on Si (100) and glass substrates in atmospheres of Ar and Ar+N mixture, respectively. The power supplies applied to the Mn and Al targets were fixed at 30 watt and 150 watt. The optical and structural properties were studied from X-ray diffraction and Fourier Transform Infrared spectroscopy (FTIR) spectrum. The crystal structure of the AlN/Mn multilayer´s obtained from x-ray spectrum show peaks associated of the cubic phase of the each layer, respectively. FTIR spectra evidenced vibrational active Raman modes of AlN located at 500 cm^{-1} and 900 cm^{-1}, identified as $E_1(TO)$, and $E_1(LO)$.Vibrating sample magnetometry and AC susceptibility were used to explore the magnetic behavior of the layers at different temperatures. The layers show ferromagnetic behavior beyond room temperature.

3 - 14 – Spin relaxation mechanisms in the impurity band of semiconductors

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We explore spin-relaxation mechanisms of the electronic spin in the impurity band of n-doped semiconductors. We propose two spin relaxation mechanisms made possible by the spin-orbit interaction of electrons in the impurity band, which are analogous to the Rashba and Dresselhaus couplings that are present in semiconductor nanostructures. The spin relaxation time is obtained by means of numerical calculation of the time evolutions of initially pure spin states. We find that both the Rashba and Dresselhaus interactions are relevant in terms of spin relaxation, but surprisingly the latter dominates over the former. The spin relaxation times found are slightly shorter than the experimental ones available in the literature, which shows the relevance of the mechanisms studied here. The quantitative disagreement could be explained by the simplifications made in our model calculations, like for example the neglect of electron-electron and electron-phonon interactions.

3 - 15 – Interaction of solids with twisted light

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We study the interaction of solids and nanostructures with light carrying orbital angular momentum (twisted light). We find the selection rules that regulate the optical transitions induced by twisted light in bulk semiconductors, and quantum wells, dots and rings. We describe the electrical currents generated in these material systems and the transference of angular momentum from light to matter. For bulk, quantum wells, and quantum rings we developed equations of motion which describe the quantum dynamics of the photo-excited electrons and solve them analytically up to first order in the applied twisted-light field.

3 - 16 – Lateral confinement effects on the magnetic domains arrangement of MnAs micrometric bars

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One of the major challenges of spintronics development nowadays is the capability of integrating semiconductors and ferromagnetic materials in multifunctional devices. In this field, the MnAs alloy is a promising material due to the facts that it presents ferromagnetism until 314K and grows epitaxially on GaAs. The typical size of a magnetoelectronic device is 50-1000 nm, so it is important to look at the physical properties of MnAs in the nanoscale. Previous studies performed on MnAs thin films indicate that the structural and magnetic properties of these materials differ from those of the bulk. A magneto-structural phase coexistence is observed in a broad temperature range just below the Curie temperature, formed by an hexagonal ferromagnetic phase (α) and an orthorhombic paramagnetic phase (β). This phenomenon is explained in terms of substrate-induced strains. The α and β phases are organized in a regular pattern of stripes when the film is deposited onto GaAs[100] while they are randomly organized when the film is grown on GaAs[111]. In this work we present a study of the magnetic properties of MnAs(120nm)/GaAs[100] micrometric bars. Samples of different width and constant length were fabricated by electron lithography. The bars were oriented parallel and perpendicular to the hard-magnetic axis of the system, i.e. c-axis. The magnetic imaging of the micrometric bars was made by magnetic force microscopy between 24°C and 11°C. Our results indicate that the α/β phase coexistence and the magnetic domain arrangement depend on the size and the orientation of the bars, while the alignment of the striped parallel to the axis is preserved in both orientation of confinement.

3 - 17 – Highly anisotrophic domain wall velocity in MnAs/GaAs (001) thin films

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In most of the commercial magnetic storage available devices, the magnetization is still controlled by applying short magnetic field pulses supplied by a current line located above the magnetic cell. Nevertheless, this technique is still subject to severe impediments, like the influence of stray fields over the adjacent cells or the large power required for switching the magnetic state, which limit the device scalability. One alternative method would be to store information on magnetic domains separated by domain walls along a magnetic track[1]. Moving the domain walls by a current using the spin transfer process would allow for information retrieval by a fixed reading head. For that purpose hybrid heterostructures based in the (III,Mn)V family, which combine magnetic and transport properties, have proved to be of great interest. Morever, these films present a strong in plane uniaxial anisotropy, which is an advantage taking into account that the out-of-plane geometry might limit the domain wall velocity[2]. Up to now there has been very few studies of domain structure and domain wall propagation in (III,Mn)V heterostructures with in-plane magnetization[3]. The first step is to investigate the domain structure and domain wall propagation in an applied magnetic field, which can provide the key parameters for current-driven propagation[4]. We combine magneto optical imaging and magnetic pulse technique to study the domain wall dynamics in MnAs/GaAs (001) thin films with in plain magnetization. The domain wall velocity is found to be highly anisotropic, and, surprisingly enough, does not seem to depend on temperature, even in the interval where both ferromagnetic α and paramagnetic β phases coexist [1]. This fact suggests different magnetization reversal mechanisms in both easy and hard magnetic axes and rises the question of which is the role of the beta phase in the domain wall pinning. Several features of the domain wall nucleation and propagation

recently predicted[6] for this system were contrasted in our experiments, showing a good agreement with the model for the domain dynamics.

[1] S. Parkin et al. Science 11, 190 (2008). [2] J.-P. Adam, N. Vernier, J. Ferré, A. Thiaville, V. Jeudy, A. Lemaître, L. Thevenard, and G. Faini, Phys. Rev. B 80, 193204 (2009). [3] Herrera Diez, L. H.; Kremer, R. K.; Enders, A.; Rössle, M.; Arac, E.; Honolka, J.; Kern, K.; Placidi, E. & Arciprete, F. , Phys. Rev. B, 78, 155310 (2008). [4] A. Dourlat, V. Jeudy, A. Lemaître, and C. Gourdon, Phys. Rev. B 78, 161303(R) (2008). [5] V. M. Kaganer, B. Jenichen, F. Schippan, W. Braun, L. Däweritz, and K. H. Ploog, Phys. Rev. Lett. 85, 341 (2000); Phys. Rev. B 66, 045305 (2002). [6] R. Engel-Herbert and T. Hesjedal, Phys. Rev. B 78, 235309 (2008)