Magnetic order and two-band transport in MnAs epitaxial films

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Metallic MnAs is a promising material for uses in semiconductor-based spintronic devices. In fact, bulk MnAs is ferromagnetic at room temperature and has an hexagonal structure (alpha) whose lattice parameters match very well with those of GaAs. The bulk material undergoes a first order transition at T*=40 C between the low temperature hexagonal ferromagnetic phase and a paramagnetic orthorhombic one. We have been studying the physical properties of MnAs epilayers, finding that they are strongly affected by growth conditions and substrate. In this talk, I will present some recent results about the magnetic and magnetotransport properties of MnAs films grown on GaAs of different orientation. I will introduce new evidences about the coexistence of the alpha and beta phases below T* in thin films. Moreover, we showed through FMR experiments that the alpha-phase is oriented perpendicular to the substrate surface for MnAs/GaAs(111) films while it lays along the substrate plane for MnAs/GaAs(100) ones. A detailed study of the thermal and angle dependence of the films coercivity reveal the existence of different activation mechanisms for domain movements in the samples. On the other hand, the magnetoresistance and the Hall effect results put in evidence the coexistence of both, hole and electron carriers in the films. The temperature dependence of the ordinary Hall constant and the transverse magnetoresistance allow us to identify a transition between electron- and hole-dominated transport regimes. The field dependence of the transverse magnetoresistance is analysed in terms of size effects and cyclotron orbital motions.

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