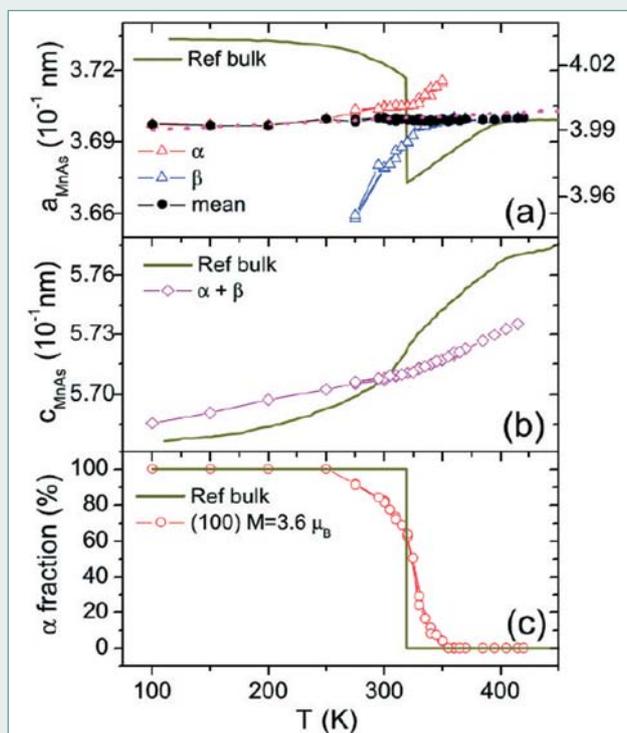


[C11. V. Garcia] Magneto-structural phase transition in MnAs epilayers grown on GaAs(111)B substrates

MnAs thin films have recently attracted considerable interest due to their growth compatibility with GaAs, and potential applications in spintronics with semiconductors. Bulk MnAs is ferromagnetic in the hexagonal α -phase from low temperature to 313 K where it displays a first-order phase transition to the orthorhombic β -phase. Thin films grown on GaAs(111)B substrates have good crystalline quality with a single epitaxy, atomically sharp MnAs/GaAs interfaces, and smooth surfaces. Also the magnetic phase transition is extended to higher temperature (335 K) in MnAs/GaAs(111)B systems, which is of great interest as the main limitation of MnAs for applications is its low Curie temperature. The evolution of the in-plane and out-of-plane parameters of MnAs epilayers was followed from 100 to 420 K using neutron diffraction (4F1 spectrometer, LLB) to understand the link between structural and magnetic properties in MnAs thin films. The main results from these experiments are summarized in the figure: (i) Contrary to bulk material, the mean in-plane parameter is almost constant from 100 to 420 K and follows that of GaAs due to epitaxial strain. (ii) This epitaxial strain induces an α - β phase coexistence in a wide temperature range (275–350 K). (iii) At low temperature, the α -phase is subject to large in-plane compression but the magnetic moment is close to that of the bulk material ($\approx 3.6 \mu_B$), the β -phase nucleation induces partial relaxation of the ferromagnetic phase up to 350 K, where it disappears. (iv) The unit-cell volume is almost constant before and after the phase coexistence, suggesting that the volume variation is not the leading parameter of the loss of magnetism. We think that the magnetic phase transition could be extended to higher temperature in MnAs epilayers grown on an appropriate substrate having a slightly different in-plane parameter or dilatation coefficient.

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Temperature dependence of structural parameters of a 100 nm thin film of MnAs grown on GaAs(111)B substrate. (a), (b) temperature dependence of the in-plane and out-of-plane parameter for both phases deduced from neutron diffraction on MnAs(100) and MnAs(002), respectively. The in-plane and out-of-plane parameters of bulk MnAs are added. (c) α -phase fraction deduced from integrated intensity of the spectra along MnAs(100) and considering a constant magnetization per Mn. The mean in-plane parameter calculated from this α -phase fraction, is added in (a) together with the evolution of the GaAs parameter.