Epitaxial growth of nearly equiatomic MnGaGe thin films on GaAs(001)- and GaAs(111)-(1x1)B reconstructed surfaces

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Bulk intermetallic MnGaGe compound is a ferromagnet with a Curie temperature of about 450 K whose crystal structure is characterized by Mn atoms arranged in basal planes of a tetragonal cell (space group number 129) which are separated by two nonmagnetic layers consisting of gallium and germanium atoms. Due to crystal and electronic magneto-lamellar structures, the MnGaGe is considered a pseudo two-dimensional ferromagnet, an alternative to the family of delicate van der Waals ferromagnetic materials [1]. In this work, MnGaGe thin films were grown on commercial epi-ready GaAs substrates by molecular beam epitaxy technique. In situ reflection high energy electron diffraction and ex-situ, x-ray diffraction techniques were used to investigate the epitaxial relationships and chemical ordering of nearly stoichiometric MnGaGe compounds with thicknesses ranged in between 10 to 100 nm. The surface stoichiometry of the films was determined by in-situ x-ray photoelectron spectroscopy. The optimization procedures of the growth conditions on GaAs(001)- and GaAs(111)-(1x1)B reconstructed surfaces include simultaneous shutter opening of the Mn, Ga, and Ge Knudsen cells by keeping substrate temperatures at 100, 200, 300, 400 Celsius with subsequent in-situ thermal treatments by two hours at different temperatures.

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Reference:

[1] Unveiling ferromagnetism and antiferromagnetism in two dimensions at room temperature
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