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Mn Nanodot Embedded in Semiconductor GaAs(001) Growth and Magnetic Properties

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Recently, there have been increasing studies on the fabrication of quantum dots of nanosized fine structure because of their unique physical properties in electronics, optics and magnetism. It is drawing great interest for their potential use in future high density optical and magnetic media storage devices. Adam et al. reported the Cuirre temperature (T_C) of 111 K of (Ga, Mn)As nanodots [1]. Kowalik et al. reported the TC of above 330 K and 260 K for type-I and type-II

MnAs nanodots, respectively. Type-I and type-II MnAs nanodots have different MnAs nanodots growth modes: both Mn and As sources are opened for type-I, or by an atomic layer epitaxy-like technique (first an Mn layer is deposited then the Mn source is closed and the As source is opened) for type-II. Recently, we reported the Mn growth on GaAs(001) at 400oC, which showed the island-growth mode and TC above 750 K [3]. We suggested that the Mn nanodots embedded in GaAs(001) will have the high TC and magnetization (M_S). It promises to further application in the spintronics devices, as mentioned.

The Mn nanodots were grown on GaAs(001) by using molecular beam epitaxy. The 2000Ao GaAs(001) buffer were grown at 550oC. The 10Ao Mn layer were grown at 400oC followed by GaAs(001) layer with difference thickness such as 100, 200 and 300Ao. The samples were caped by 200Ao GaAs(001) layer to avoid the oxidation of inner layer. The reflection high energy diffraction (RHEED) patterns show spotty, which indicating the island-growth, as expect for growth Mn nanodots. The resistance was increased rapidly with decreasing temperature indicating that the sample have semiconductor behavior. The magnetic properties were carried out by the superconductor quantum interface devices (SQUID) measurement, which showed the T_C above room temperature. The detail of growth of Mn nanodots, magnetic properties and also transport properties will be discussed.

References

[1] J. P. Adam et al., Phys. Rev. B **80**, 155313 (2009).

[2] Kowalik et al., arXiv: cond-mat/0702444v1.

[3] Hwang et al., Phys. Rev. B **79**, 045309 (2009).