Magnetic properties of Be-codoped GaMnAs

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Ferromagnetic semiconductor has recently attracted great attention as a promising material for spin electronic devices application. GaMnAs has been the most intensively studied material, but its Curie temperature was limited to ~110K due to the solid solubility limit of Mn in GaAs, and consequently, a segregation of MnAs.[1] In the meantime, recently the authors have shown that the magnetic property of GaMnN can be improved by codoping of another type of acceptor, Mg.[2] Magnesium is a better dopant than Mn in the efficiency of the carrier excitation, and thus, the film revealed a higher conductivity and magnetization. It was interpreted as an enhanced carrier mediated ferromagnetism. In the codoping process, the incorporation of Mn was reduced through a competition with Mg incorporation. When this occurs in codoping for GaMnAs, one may expect similar increase of the conductivity as well as a reduction of the segregation. The net result is an increae of the Curie temperature.

Therefore, it is interesting to investigate the behavior of Be-codoped GaMnAs films in the electrical and magnetic properties. Be is a widely used p-type dopant for GaAs. We examined the structural, electrical, and magnetic properties of the GaMnAs:Be films grown via low-temperature molecular beam epitaxy with varying Mn flux at a fixed Be flux. No x-ray diffraction peaks for precipitate were observed. We observed a conductivity increase of the Be-codoped GaMnAs films as expected. All the samples also showed metallic behavior in the temperature dependent resistance measurements. The Hall effect measurements with varying magnetic field showed clear anomalous Hall effect above 100K. This is a definite improvement of the magnetic property of GaMnN. Detail discussion on the effects of the Be codoping with respect to the properties of the GaMnAs grown without Be-codoping.

References

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