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Behavior of the precipitates in GaMnN by heat treatment

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Ferromagnetic semiconductor has recently attracted great attention as a promising material for spin-injection devices. GaMnN has been shown to be ferromagnetic at room temperature, but it requires high concentration of carriers for spin-injection. Thus far, the homogeneous GaMnN films as well as other magnetic semiconductors have revealed high resistivity so that the magnetotransport properties were seldom observed. However, the room-temperature operating semiconductor GaMnN is known to be improved in its magnetic property when a highly conductive precipitate Mn_3GaN exists.[1]
Therefore, it is useful to investigate the behavior of the precipitate with heat treatments for further improvement of its magnetic property. GaMnN layers were grown in molecular beam epitaxy using a single GaN precursor. For high Mn flux, the major precipitate was Mn_3GaN, but sometimes mixed with Mn_4N. With the heat treatment, Mn_3GaN decomposed and a new phase of Mn_3Ga has generated. The kinetics was further accelerated by neutron irradiation, which might generate defects in the lattice and assist the decomposition of N and/or the formation of Mn_3Ga. The saturation magnetization of the homogeneous GaMnN layer was increased after heat treatment while it was decreased for precipitated GaMnN. The increase and decrease of the magnetization of the heat-treated GaMnN epitaxial layers were explained consistently by the behavior of the precipitates.

References

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