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The important role of Ga vacancies in the ferromagnetic GaN thin films

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Abstract

Room-temperature ferromagnetism was observed in the unintentionally doped GaN films, which were fabricated using laser molecular beam epitaxy followed by annealing process at different temperatures from 800 to 1000℃ for 25 min in flowing nitrogen gas. The annealing temperature has a prominent effect on the crystalline quality, the surface morphology, the concentration of Ga vacancies and the magnetic properties of the GaN films. It is found that high temperature annealing process is an effective means of introducing Ga vacancies, which play an important role in the origin of room-temperature ferromagnetism in the GaN samples. The Ga vacancy-related ferromagnetism may be an assistant mechanism in the Mn-doped GaN films, but it is dominant in the unintentionally doped GaN films, which deserves further study to develop novel diluted magnetic semiconductors without dopants.

Keyword: GaN; thin film; DMS; LMBE; annealing.