The investigation of GaN thin films deposited by r.f. reactive magnetron sputtering

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ABSTRACT

The characteristics of gallium nitride (GaN) thin films deposited by r.f. reactive magnetron sputtering are studied. The deposition parameters are constant during sputtering (e.g. the r.f. power, deposition pressure, substrate temperature) besides the nitrogen partial pressure of sputtering atmosphere. The effects of films deposited at different nitrogen content of sputtering gases are discussed. When the films are deposited at higher nitrogen content, the deposition rate is lower, the surface morphologies of films become more flat and the resistivity is higher. Contrarily, when the films are deposited at lower nitrogen content, the deposition rate increases. However, the surface morphologies of films become rough and the resistivity becomes low. Persistent photoconductivity (PPC) behavior was observed in the sputtered GaN films. The films deposited at higher nitrogen partial pressure present the more obvious PPC. For example, the films deposited at 20% nitrogen content of sputtering gases present at a level 60% higher than the equilibrium dark current for over one hour after removing the photoexcitation. The " erase " method for PPC behavior by heating samples to the different temperatures was experimented. The PPC can be erased at the appropriate temperature. Although the PPC has deleterious effects on both optic and electric device, the PPC behavior is similar to the optical memory effect, i.e., " writing " with photoexcitation, and it can be " erased " by appropriate thermal energy. In this thesis, the possible traps distributions are measured by current－temperature and thermally stimulated current measurement. The activation energy and the possible trap levels are calculated. The descriptions of PPC processes and thermal effects on PPC are discussed. The possible trap levels distribution is proposed.

Keywords : GaN ; sputter ; PPC

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