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Microstructures of GaN films deposited on (001) and (111) Si substrates using electron cyclotron resonance assisted–molecular beam epitaxy

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The microstructures of GaN films, grown on (001) and (111) Si substrates by a two-step method using Electron Cyclotron Resonance assisted–Molecular Beam Epitaxy (ECR-MBE), were studied by electron microscopy techniques. Films grown on (001) Si had a predominantly zinc-blende structure. The GaN buffer layer, grown in the first deposition step, accommodated the 17% lattice mismatch between the film and substrate by a combination of misoriented domains and misfit dislocations. Beyond the buffer layer, the film consisted of highly oriented domains separated by inversion domain boundaries, with a substantial decrease in the defect density away from the interface. The majority of defects in the film were stacking faults, microtwins, and localized regions having the wurtzite structure. The structure of the GaN films grown on (111) Si was found to be primarily wurtzite, with a substantial fraction of twinned zinc-blende phase. Occasional wurtzite grains, misoriented by a 30° twist along the [0001] axis, were also observed. A substantial diffusion of Si was seen in films grown on both substrates.

Keywords: Electronic materials; Molecular beam epitaxy (MBE); Thin film
Materials: GaN/Si

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