Impact of Carrier Gas on the GaN Layers Properties Grown on (001) and $(11n)$ GaAs Substrates by AP-MOVPE: Comparative Study

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Received February 1, 2020
Revised February 10, 2020
Accepted February 10, 2020

The impact of carrier gas on the GaN layers properties grown by atmospheric pressure metal-organic vapor-phase epitaxy (AP-MOVPE) on (001) and $(11n)$ GaAs substrates were investigated. The Arrhenius plots of growth rate deduced from laser reflectometry measurements give an activation energy of $E_{a1} = 0.045$ eV when the H_2 was used as the carrier gas. In the case of using N_2 as the carrier gas, the results give $E_{a2} = 0.081$ eV as a value of activation energy, which is approximately 2 times greater than E_{a1}. Scanning electron microscopy results show that when N_2 is used, the resulting material quality is low, but the use of H_2 is successful to prevent the cracking of GaN layers and results in improvement of crystalline properties. From the X-ray diffraction result, we conclude that both (001) and (113) GaAs substrate orientations as well as the use of H_2 as the carrier gas favors the GaN growth with cubic structure, whereas the GaN hexagonal structure is favored for growth on (112) and (111) GaAs substrates orientations with N_2. Cathodoluminescence measurements show that a mechanism of phase transformation occurs when the growth temperature rise from 800 to 900°C.

Keywords: cubic GaN, hexagonal GaN, (hkl) GaAs, carrier gas.

Full text of the paper will appear in journal SEMICONDUCTORS.