Electronic and Optoelectronic Devices Using Quaternary AlInGaN Layers

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Our group is working on a new Strain and Energy Band Engineering approach (SEBE) to modulate strain and hence optical and electrical properties of III-N photonic and electronic devices by introducing quaternary AlInGaN-AlInGaN heterojunctions in their active region. A unique pulsed atomic layer epitaxy (PALE) approach which is used for the deposition of these quaternary layers. Recently using GaN-InGaN – AlInGaN double heterojunctions and SiO_2 layers under the gate we demonstrated current-collapse free MOSHFET devices with stable rf-powers as high as 7 W/mm and gate-leakage currents 4-6 orders less, then those of conventional HFETs. We have also succeeded in fabricating deep-ultraviolet light-emitting diodes using AlInGaN MQWs in the active region. Emission powers as high as 1 mW and wavelengths as short as 300 nm have been demonstrated for stripe-geometry devices over sapphire substrates. We will present detailed characterization results to discuss the role of strain and its management via quaternary AlInGaN layers.