Demonstration of the Improvement of III-V/High-*k* Interface Quality Utilizing in-Situ NH_3/N_2 Remote Plasma

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Abstract

In this work, methodologies of surface termination and native oxide removal on $In_{0.53}Ga_{0.47}As$ using NH_3/N_2 remote plasma treatment are studied. Surface roughness mobility, interface quality along with carrier lifetime are conspicuously improved. Through such plasma treatment, the density of interface trap states (D_{it}) is dramatically reduced and the surface morphology of the Al_2O_3 is modified. Beside the sharp decline in the D_{it}, the Al_2O_3 layer becomes flatter and thus results in a significant enhancement in the surface roughness mobility combining the observations from experiment as well as simulation results. From the Transmission Electron Microscope (TEM) we observe an improvement of surface flatness. Also, we found a considerable enhancement in the surface roughness mobility from 7×10^{24} to 1.5×10^{26} cm^2/Vs and the channel carrier lifetime dramatically increased from 12 to 1300 ps with the assist of TCAD simulations. Moreover, the mid-gap trap decreases from 7×10^{12} to 3×10^{12} cm^{-2}/eV^{-1}, which once again emphasis the achievements of this work.