Submitted to Journal of Applied Physics

Role of MgO buffer layer on defect reduction of P-MBE grown ZnO layer on c-sapphire

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Abstract

We have investigated the role of low temperature (LT)-MgO buffer layers on defect reduction of ZnO layers grown on c-sapphire by plasma-assisted molecular beam epitaxy (P-MBE). Buffer growth parameters consisting of thickness, growth rate, and annealing were evaluated. We found that surface morphology and crystalline quality of the ZnO layers were improved by controlling the buffer layers. There is no improvement in morphology and crystalline quality of the ZnO layers if the buffer thickness is less than critical thickness. The critical thickness is determined to be 1.5 nm for MgO buffer. We also found that low growth rate of the buffer layers is preferred for high quality ZnO layer. Furthermore, surface, structural, optical, and electrical qualities of the ZnO layers were improved by annealing MgO buffer at high temperature. Dislocation density of the ZnO layer was reduced from 5.3 $x10^9$ cm^{-2} to 1.9 $x10^9$ cm^{-2} by annealing the MgO buffer layer. The results indicate that we can engineer defect in highly mismatched heteroepitaxial using buffer layers.

Keywords: *ZnO, MgO, Plasma-assisted MBE.*