Abstract

AlGaN is an important semiconductor material for electronic and optoelectronic applications. The change in composition of AlGaN (AlN to GaN) provides a range of bandgaps extending from 6.01 eV, far ultraviolet, to 3.4 eV. This higher bandgap results in a higher breakdown voltage, than GaN one of the current materials of choice, in the devices made out of it. Carrier transport is also less sensitive to temperature variation. Hence, AlGaN with high Al fraction is a suitable candidate for power transistor technology. For optoelectronic applications like UV-photodetectors and UV-emitters, the full range of AlGaN provides the tunability in wavelength ranging from 206 nm (AlN) to 360 nm (GaN). As the solar spectrum ranges from about 250 nm to 2500 nm, AlGaN with high Al fraction is useful for solar-blind UV applications. AlGaN UV emitters on the other hand can be used in water purification. Till date all these developments have been carried out by growing AlGaNs on expensive substrates like SiC, sapphire or freestanding AlN. But the growth of AlGaN on Si (111) substrates are desirable as opposed to commonly used substrates such as sapphire, SiC or AlN owing to its higher thermal conductivity (except SiC), low cost and availability in large area. Integration with Si opens up the possibility to integrate the multifarious applications of AlGaN with the economic viability of Si (111) substrates. The present work focuses on the integration of AlGaN on Si (111) substrates by MOCVD. The bounds placed on the competing requirements composition, thickness, stress, defect density and surface roughness due to the physico-chemical aspects of AlGaN growth have been identified. Using such understanding an AlGaN/AlGaN high electron mobility transistor and a UV detector have been demonstrated.