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Properties of Al_2O_3/AlN/GaN metal-oxide-semiconductor junctions with different Al_2O_3 thicknesses

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GaN and related materials have gained considerable interest due to the wide applications to electronic and optoelectronic devices such as light emitting devices, high-power, high-temperature, high-frequency devices. Among high-k dielectric materials, Al_2O_3 is a very stable and robust material, and as an alternate gate dielectric Al_2O_3 has many favorable properties, including a high band gap, thermodynamic stability on Si up to high temperatures. However, high interface trap density in Al_2O_3/GaN interface is a big obstacle in the device performance. Therefore, surface passivation is pivotal to minimize such interface trap density, which eventually improve the device performance. Atomic layer deposition (ALD) grown AlN layer has been reported as an alternative method to passivate AlGaN/GaN devices for its good isolation stability and high interface quality in AlGaN/GaN. Here, we deposited ultrathin AlN layer by ALD in Al_2O_3/GaN metal-oxide-semiconductor (MOS) capacitors and their interfacial and electrical properties were investigated with different Al_2O_3 thicknesses. X-ray photoelectron spectroscopy (XPS) measurements showed that the diffusion of N atoms into Al_2O_3 and the degradation of Al_2O_3 film quality were significant when the Al_2O_3 thickness is 10 nm. In addition, the sample with a 10 nm thick Al_2O_3 revealed the highest leakage current and interface trap density. Other techniques such as temperature dependent current–voltage (*I–V–T*) measurements applied to the samples, and the detailed analyses based on the data will be presented later.

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