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Effect of annealing on RF sputtered aluminum nitride buffer layers for GaN growth

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The column III-nitride semiconductors are attracting much attention for high-brightness blue and green light emitting diodes and blue laser diodes. GaN based devices are usually obtained by hetero-epitaxial growth on sapphire and SiC substrates. However, conventional methods using sapphire or SiC substrates are hard to commercialize due to the high cost fabrication. On the other hand, GaN on Si has attracted a lot of research interests because silicon substrates give the large areas and low cost fabrication. Silicon substrates have cubic structure, larger lattice constant and difference in thermal expansion coefficient between GaN and silicon. These result in many dislocations and cracks. To minimize the dislocations and eliminate the cracks, we need the buffer layers to reduce lattice mismatch and difference in thermal expansion coefficient between GaN and the substrates. There are many kinds of buffer layers, for instance AlN, SiN, ZnO, LT-GaN, etc. Among the Aluminum nitride (AlN) has the wurtzite structure which is 2.5% lattice mismatch compared with GaN, 33% difference in the thermal expansion coefficients. Also it is essential to eliminate the stresses and control the mirror like surfaces in AlN buffer layers to obtain the high quality GaN epitaxial layer. In this study, we expected to reduce the stresses and improve the crystallinity and surface morphology by annealing. We grew AlN buffer layers on silicon substrates by reactive RF sputtering. And then the sputtered AlN buffer layers were annealed at various temperatures for 30min in nitrogen atmosphere. The surface morphology and roughness were observed by using scanning electron microscopy (SEM) and atomic force microscopy (AFM), respectively. And the crystal structure and lattice constant were analyzed by X-ray diffraction (XRD).