GaN Schottky barrier photodiode on Si (1 1 1) with low-temperature-grown cap layer

Abstract

In this work, GaN films were grown on three-inch silicon substrates by plasma-assisted molecular beam epitaxy (PAMBE) with AlN (about 200 nm) as the buffer layer. Finally, a thin AlN cap layer (50 nm) was grown on the GaN surface. Current–voltage (*I*–*V*) measurements before and after heat treatment were carried out. Different annealing temperatures (500–700 °C) were investigated. Under dark condition, the Schottky barrier height (SBH) derived by the *I*–*V* method is 0.48 eV for as-deposited Ni/AlN/GaN/AlN Schottky diode. On the other hand, the effective barrier heights of 0.52, 0.55, and 0.57 eV were obtained for Schottky diodes annealed at 500, 600, and 700 °C, respectively. We found that the SBHs of annealed Schottky diodes under dark and illuminated conditions were observed to be higher relative to the as-deposited Schottky diode. When annealed at 700 °C, the resulting Schottky diodes show a dark current of as low as 5.05×10^{-5} A at 10 V bias, which is about two orders of magnitude lower than that of as-deposited Ni/AlN/GaN/AlN Schottky diode (2.37×10^{-3} A at 10 V bias). When the sample was under illumination condition, the change of current was significant for the annealed samples as compared to the as-deposited sample.

Keywords: AlN; GaN; Photodiode; Schottky barrier height; Thermal annealing