THE SUMMARY OF Ph.D. DISSERTATION

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Title

Study of growth and evaluation of GaN on Si(100)

Abstract

Recently, the demand for high class integrated circuit with high speed and high device capacity have been much increased due to the development of information technologies. The device size on Si has been much down sized depending on the Moor's law. The limit of Moor's law will be decided by the electrical break down of Si crystal. The limit of gate length is around 50nm at 2010. The break through technology has been much required .One of the candidates is Opto- electronic IC(OEIC) on Si. GaN crystals are one of the most promising materials with high voltage resistant and optical emitting. If we can grow GaN on Si(100), many kind of new devices will be designed. BP crystal was selected to lattice matched with c-GaN with high affinity to Si crystals. The survey of materials are given in Chapter 1. The materials were grown by vapor phase epitaxy and MOVPE technique. The crystal growth technique are summarized in Chapter 2. The material properties of BP, c-GaN and w-GaN are summarized in Chapter 3. The BP crystal was successfully grown on Si(100) by using low temperature grown layer at the interface. This low temperature layer absorbs strains during heating process. The wafer showed no-bending with high uniformity. The growth experiments and results are given in Chapter 4.

The preliminary results of GaN growth are given in Chapter 5. The c-GaN has been grown at lower than 850 ℃. The crystal structure varied to hexagonal with growing at higher than 950℃.

The photoluminescence measurements demonstrated c-GaN on BP/Si. The edge emission corresponded to c-GaN, 3.2 eV. Next, the growth was carried out by using mass-producing machine (VTERA in Taiwan). The growth of BP on Si(100) with 2-inch in diameter were successfully carried out. The conductive type varied depending on the gas flow rate. The conductive type became n type with increasing TBP flow. This tendency will be due to the point defect generation and impurity contamination from gas sources. The surface was markedly flat. This result also strongly supports IC feasibility. These results are given in Chapter 6. The preliminary test growth experiments were carried out. The simple pn junction (GaInN) demonstrated slightly lighting. This result strongly indicates the feasibility of future devices, however the emission was weak.

The result are given in Chapter 7. The summary is given in Chapter 8.

Through this study the growth of BP on Si has been found to be successfully grown. The GaN has been found to be grown on BP/Si. The quality control of GaN and interface evaluation will be needed. It should be done in the near future.