（様式 5）

指導教員 承認印	

平成 30 年　8 月 23 日
Year　Month　Day

学位（博士）論文要旨

(Doctoral thesis abstract)

論文提出者 (Ph.D. candidate)	工学府博士後期課程　応用化学専攻 平成 27 年度(後期)入学 学籍番号　15832703　氏名　高田　和哉
主指導教員氏名 (Name of supervisor)	熊谷　義直
論 文 題 目 (Title)	Investigation of high-temperature stability of AlN, sapphire and their hetero-interface for heteroepitaxy （サファイア基板上窒化アルミニウムヘテロ成長のための表面・界面の高温安定性に関する研究）

論文要旨（2000 字程度）
(Abstract(400 words))
※欧文・和文どちらでもよい。但し、和文の場合は英訳を付すこと。
(in English or in Japanese)

Aluminum nitride (AlN) is highly expected to be applied to fabrication of deep-UV light emitting diodes since its bandgap energy is the widest of any direct transition semiconductor materials. Power devices are also promising applications of AlN because of its unique features such as high thermal conductivity and high breakdown field. In order to manufacture these devices, high quality single crystalline AlN substrates with large diameter are essential for base substrates on which device structures are fabricated.

If the heteroepitaxial growth technique of AlN on sapphire substrates becomes realized, the industry will gain tremendous economic benefit of the immediate availability of low-cost sapphire substrates up to 8 inches in diameter. The purpose of this doctoral thesis is to provide scientific knowledge about high-temperature stability of AlN, sapphire and their hetero-interface, so as to materialize the heteroepitaxial growth technique of AlN on sapphire.

In Chapter 2 of this thesis, the thermal stabilities and decomposition of Al- and N-polarity AlN layers grown on (0001) sapphire substrates were investigated in the temperature range from 1100 to 1400 °C and in various gas flows (He, H_2 and H_2+NH_3). The difference in the AlN

decomposition rates between Al- and N-polarity AlN surfaces was discussed in connection with surface bonding structure of AlN.

In Chapter 3 of this thesis, the effect of heat treatment on (0001) sapphire substrates was investigated in the temperature range 980–1480 °C for an atmospheric-pressure mixed flow of H_2 and N_2 with various molar fractions of H_2. Undesirable AlN whiskers were found on the sapphire surface only when N_2 coexists with H_2 in the temperature range of 1030–1430 °C. The decomposition of the sapphire substrate and the formation of AlN on the sapphire surface were also examined by thermodynamic analysis.

In Chapter 4 of this thesis, the formation mechanism of the above-mentioned AlN whiskers on (0001) sapphire substrates was investigated in the temperature range of 980–1380 °C in an atmospheric-pressure mixed flow of H_2 and N_2 ($H_2/N_2 = 3/1$).

Lastly, in Chapter 5 of this thesis, the mechanism and control of void formation at the interface was investigated for the reproducible self-separation of thick, large area AlN layers from sapphire substrates via voids as a predefined separation point. As a compilation of research results from Chapters 2 through 5, the self-separated freestanding AlN substrates with high UV transparency were successfully obtained.