**FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS**

| **Project Title**: Innovative crystal growth processes of nitride semiconductors based on their physical chemistry | |
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**1. Background of research**

Aluminum nitride (AlN) is a III-V semiconductor with a wurtzite crystalline structure. AlN has useful properties: it has a very wide bandgap, high thermal conductivity, and high transparency of ultraviolet light. Because of these properties, AlN is demanded for use in ultraviolet LEDs and high-power electronic devices for the next generation. High-quality AlN crystal is needed to develop the potential use of nitrides semiconductors.

**2. Research objectives**

The purpose of this study is fabrication of high-quality AlN thicker layers on nitrided sapphire substrate for homoepitaxial growth. In parallel, growth of bulk AlN crystal is also target of this study. To achieve these goals, critical issues on crystal growth of nitrides should be overcome through characterization of the crystal aiming for breakthrough in device applications.

**3. Research characteristics (incl. originality and creativity)**

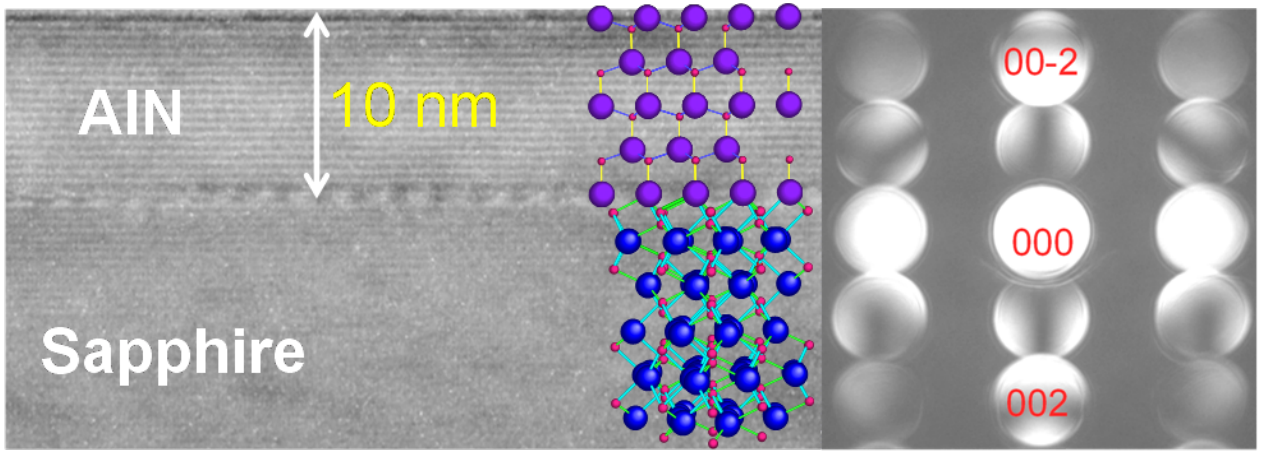
This study deals with novel crystal growth techniques such as sapphire nitridation method, Ga-Al flux method, RF-sputter method using nitrided sapphire template for fabrication of high-quality AlN thicker layers. The carbothermically reduced alumina vapor deposition is also a new approach to grow bulk AlN single crystal. Physical chemistry relating to crystal growth of AlN has been studied, which leads to develop these novel processes.

**4. Anticipated effects and future applications of research**

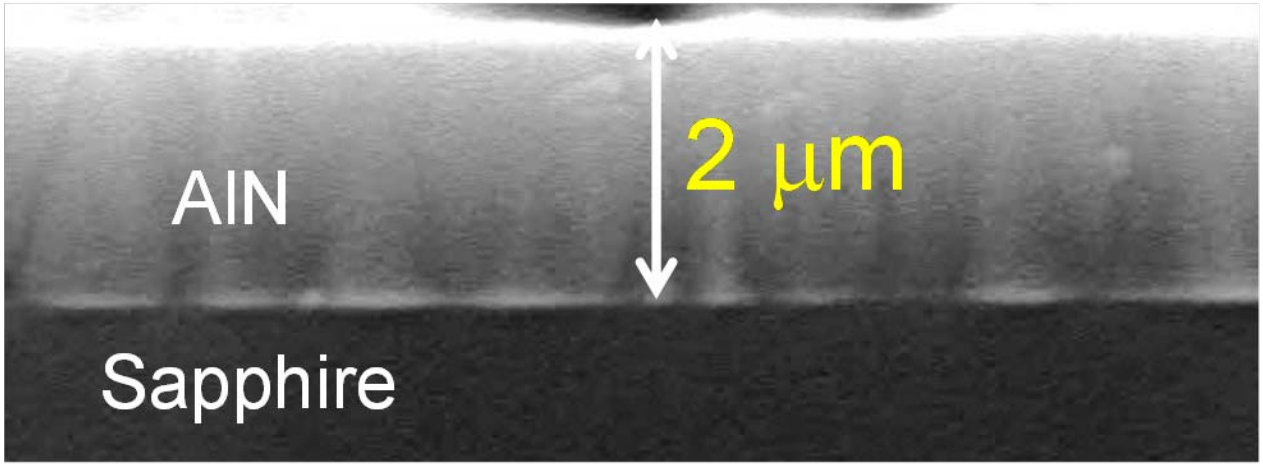
Nitride semiconductors are promising materials in deep UV devices, white color LED, high-density DVD, Medical laser, photolithography, photocatalytic decontamination (water, soil, air), alternatives of Hg lamp (254nm) and He-Cd laser (325nm). Nitride semiconductors are also applied to high-power electronic device and solar cells.

(1) High quality AlN film using sapphire nitridation method

$Al_2O_3+3C+N_2(g)=2AlN+3CO(g)$




(2) Growth of AlN using Ga-Al flux




Bulk AlN crystal