In-Situ Observation of Liquid Phase Epitaxial Growth of an AlN Layer by Optical Microscopy

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Aluminum nitride (AlN) is a promising substrate material for AlGaN-based light emitting diodes, because of its high thermal conductivity, high ultraviolet transmittance, and small lattice mismatch with AlGaN. Our group has developed several techniques to fabricate AlN layers on sapphire substrates. In particular, we fabricated high-quality single crystalline AlN thin films by thermal nitridation [1]. Moreover, using Ga-Al liquid phase epitaxy, we homoepitaxially grew an AlN layer on the single crystalline AlN thin film [2]. Using the LPE technique, a 1.2 μm thick AlN layer grew in Ga-40 mol % Al solution at 1573 K under normal pressure of nitrogen gas for 5 h [2,3]. The growth rate of the AlN layer increased with increasing Al content of the Ga-Al solution until Ga -60 mol % Al, however, the growth rate decreased with increasing Al content of the solution over Ga-60 mol % Al. Moreover, AlN film and the underlying sapphire substrate partially dissolved into the high Al content solution [2,4]. In this study, we performed *in-situ* observation of the growth interface of the AlN crystal using an optical microscope with a heating stage. We prepared the metallic Al laminated nitrided sapphire substrate as a sample, then, the growth interface was observed from the back side of the substrate through the substrate. As a result, we successfully observed 2D nucleation and lateral growth of AlN at 1073 K and at a temperature above 1453 K, respectively. Moreover, it was clarified that the origin of the dissolution of the sapphire substrate arose at a temperature below 873 K.

References:

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