Growth of Aluminum Nitride Thin Films by Thermal Laser Epitaxy

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The intriguing properties of aluminum nitride (AlN), such as ultra-wide direct bandgap, thermal and chemical stability, and high thermal conductivity, make it a promising material for high-power electronics and deep-ultraviolet optoelectronics [1]. Enhancing the surface migration of Al adatoms during epitaxy is important for growing high-quality AlN thin films. Accordingly, a high growth temperature is one of the most straightforward strategies for the growth of high-quality AlN thin film.

Thermal laser epitaxy (TLE) is a novel film deposition technique which uses continuous-wave lasers to evaporate ultrapure elemental or compound sources and to heat substrates [2]. TLE opens new opportunities for film growth because it offers very high substrate temperatures, ultrapure molecular fluxes, the possibility of deposition in highly reactive atmospheres, and most of the parameter space of chemical vapor deposition (CVD). TLE has already been used to successfully grow excellent binary oxide thin films [3,4].

In the presentation, we will demonstrate the high-temperature growth of AlN thin films on c-plane sapphire substrates by TLE. The deposition is performed by laser-evaporating pure Al sources in nitriding atmospheres produced by supplying NH3 or plasma-generated N radicals. We also discuss the effects of temperature and V/III ratio on the growth behavior, and the effects of high-temperature post-annealing.

Our results demonstrate the capability of TLE to grow nitride films. They also demonstrate the possibility to utilize both molecular beam epitaxy-like and CVD-like growth modes, also in combination.

References

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