REMOCVD による GaN ホモエピタキシャル成長のための基板の表面処理方法
Surface Treatment Method of GaN Substrates for Homoepitaxial GaN Growth by REMOCVD

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1. Introduction

Our newly developed Radical Enhanced Metalorganic Chemical Vapor Deposition (REMOCVD) has a VHF (very high frequency-100MHz) plasma and proved that the growth temperature of Gallium Nitride (GaN) can be largely decreased without ammonia gas due to radical enhanced growth [1]. GaN has excellent properties such as direct and wide band gap energy of 3.4 eV at room temperature in the hexagonal phase (Wurtzite). GaN therefore attracted much attention for their potential use in electronic devices. Major contaminants on GaN substrates are native oxides. Hence, the homoepitaxial growth of GaN on insufficiently cleaned or improperly prepared GaN substrates results in defective layers. In the present work, we focus on the surface preparation which is very essential for the growth of homoepitaxial GaN.

2. Experimental

Commercial bulk GaN and GaN template were used as substrates. Before loading GaN substrates into the chamber, the substrates were sonicated in acetone, isopropyl alcohol and deionized (DI) water and etched with 5% HF for 5 mins and finally rinsed in DI water. N_2/H_2 was used as the source gas with flow rate of 750/250 sccm respectively. The GaN substrates were cleaned by changing the substrate temperature from 400 to 900°C for 5 min with the RF plasma power of 400W. The resulted samples were evaluated by scanning electron microscope (SEM), atomic force microscope (AFM) and *in-situ* reflection high-energy electron diffraction (RHEED).

3. Result and discussion

Substrates cleaned with 400W plasma power revealed that up to 600°C the GaN surface looks flat beyond which the surface gets damaged. The RHEED pattern showed steak lines for plasma-cleaned samples above 600°C with 400W plasma power as shown in Fig. 1. Similarly, plasma power increased beyond 400W results in rough surface confirms plasma etching.

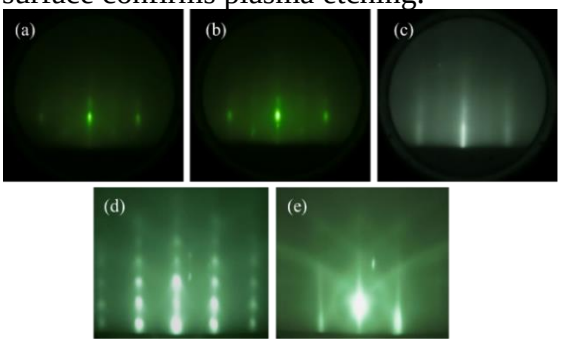

Fig. 1 RHEED patterns (a) bulk GaN as received, (b) after wet etching, (c) after plasma cleaning, (d) ramping up to 800°C without plasma, and (e) ramping up to 800°C with plasma

Also, the temperature ramp-up performed without plasma power on cleaned substrates leads to N out-diffusion forming Ga droplets. At high temperature and high plasma power the substrate surface gets damaged.

4. Conclusion

From the present results, it was found that temperature ramping up to the growth temperature using plasma is essential to avoid N out-diffusion. Plasma treatment is thus found necessary for the homoepitaxial growth of GaN.

Acknowledgments

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Reference

[1] Yi Lu et al., J. Crystal Growth. **391**, 97 (2014)