Properties of SiCN films prepared by Cathode Coupled P-CVD Using Liquid Source Material

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Introduction

Plasma Chemical Vapor Deposition (P-CVD) is a method for obtaining the functional films such as SiN, SiO_2. These films are indispensable in fields such as semiconductor, optics and MEMS, etc.

Plasma Chemical Vapor Deposition (cathode-coupled P-CVD)

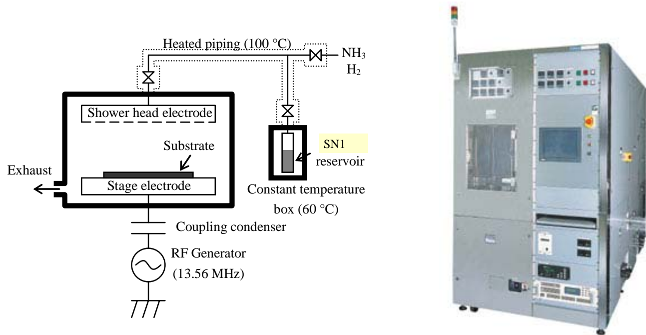


Fig.2 Concept of the plasma chemical vapor deposition technique.

Basic characteristics of SiCN films

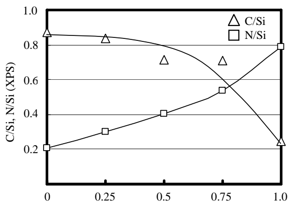


Fig.4 Variation of C/Si and N/Si in SiCN films as a function of the flow ratio $H_2/(NH_3+H_2)$

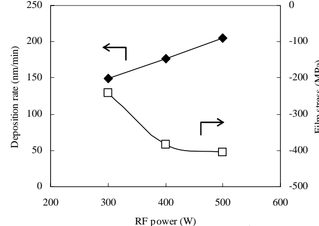


Fig.5 Rerations between deposition rate and film stress and RF power.

- It is impossible to controlled the content of C/Si.
- The films stress, negative values means compressive, increased from -240 MPa to -405 MPa with RF power increase, and saturated at -405 MPa.

Application for MEMS

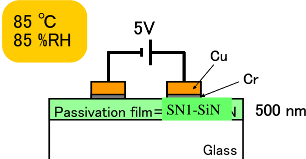
By chemical stability of SiCN films, we consider that SiCN films can be applied wet etching mask or self-supporting films for MEMS devices.

Table 1 Wet etching rates for base/acid solutions.

Etchant	Concentration (wt%)	Etchant temp. (°C)	Etching rate (nm/min)
BHF	HF 7.1 NH_4F 34.3	25	0.018
KOH	30	85	0.058
TMAH	25	80	0.018

Application for diffusion barrier of metal

These results were considered that the diffusion of Cr metal or impurities contained grass substrate was pro-tected using SiCN film, and considered that it is a wet-proofing in the SiCN film.



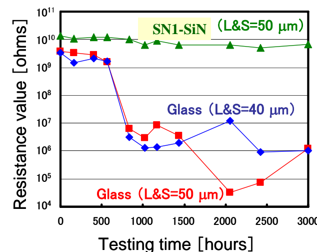


Fig.6 Life-time test of resistance for SiCN coated and bare glass.

Application for optical film

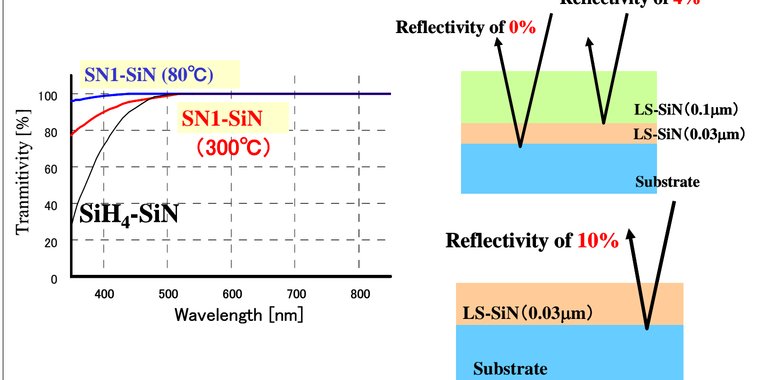


Fig.7 Optical transparency of SiCN and SiH_4-SiN.

- SiCN film is possible on region substrates for instance, plastic.

Application for ELO-GaN

The result of ELO using the SiCN stripe film shows that the GaN(0001) crystal grows up, and there is no imperfect alignment from <0001> direction because the both dif-fraction peaks, ϕ=0° and ϕ=90° , are single. On the other hand, even when SiH_4 use SiN film is used as a ELO mask, crystallinity of GaN(0001) is almostly the same level in case of SiCN ELO mask. However, because the diffraction peak, ϕ=90° , is not single, it means imperfect alignment from <0001> direction.

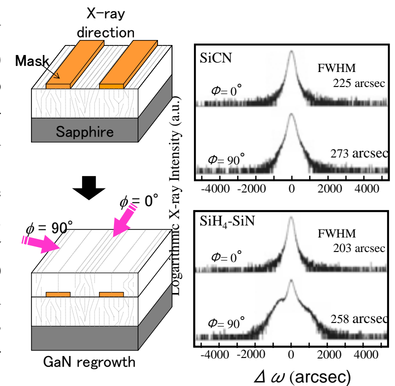


Fig.8 X-ray rocking-curve of ELO GaN using SiCN and SiH_4-SiN masks.

Application for Semiconductor

We deposited the SiCN films using Cathode Coupled and Anode Coupled P-CVDs. The SiCN films have unique characteristics which SiH_4 use SiN films does not have. We consider that the SiCN films are candidate material for the practical applications in various industrial fields.

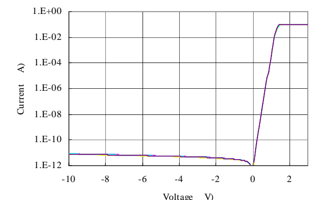


Fig.9 *I-V* characteristic of SiCN passivated pin diode.

Conclusion

We deposited the SiCN films using Cathode Coupled and Anode Coupled P-CVDs. The SiCN films have unique characteristics which SiH_4 use SiN films does not have. We consider that the SiCN films are candidate material for the practical applications in various industrial fields.

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References

[1] A. Ogishi, S. Motoyama, M. Sawai, T. Tatsuta and O. Tsuji, *Jpn. J. Appl. Phys.* **42** (2003) L1090