課題番号　:F-18-NU-0083
利用形態　:機器利用
利用課題名（日本語）　:
Program Title (English)　:GaN integration with amorphous substrates via silicon seed layers fabricated by aluminum-induced crystallization
利用者名（日本語）　:
Username (English)　:M. Hainey, Jr., N. Usami
所属名（日本語）　:名古屋大学大学院工学研究科
Affiliation (English)　:Graduate School of Engineering, Nagoya University
キーワード／Keyword　:成膜・膜堆積, アルミニウム誘起結晶化法, ヘテロエピタキシャル成長用シード層

1. 概要（Summary）

In this project, the fabrication of silicon thin films fabricated by electron beam evaporation is compared to those fabricated by RF Sputtering (in Usami Lab). The different energetics involved in the two processes will influence the final film morphologies, even if process parameters such as vacuum level or deposition rate remain roughly the same.

These silicon films are to be used as seed layers for heteroepitaxy. However, rough surfaces will interfere with uniform epitaxial growth, and must be mitigated. Previously, films in the Usami laboratory have been made by sputtering. However, sputtering is an energetic process that is known to damage underlying substrates or films. Therefore, replacing sputtering with a less energetic electron-beam evaporation process is desirable.

2. 実験（Experimental）

【利用した主な装置】電子ビーム蒸着装置

【実験方法】

Glass substrate cleaning is performed in the Usami laboratory prior to deposition. Samples are transported to cleanroom in deionized water. Al is deposited at 1.5-2.0 Å/s followed by a 3 min air exposure. Amorphous silicon is subsequently deposited at similar deposition rates after pumpdown. Base pressures for both processes are ~1x10-4 Pa. Film thicknesses are roughly 30 nm.

For the aluminum-induced crystallization process, the Al/oxide/Si stacks were annealed at 425-500°C for 2hrs in an argon ambient. The Al layer was etched using a 10:1 DI Water: HF solution before samples were imaged via scanning electron microscope.

3. 結果と考察（Results and Discussion）

From Fig. 1 and 2, the difference in surface roughness of the Si films can be clearly seen. These results suggest that electron-beam evaporation, a less energetic thin film deposition process, can produce Si films with a smoother surface morphology, making them suitable for subsequent heteroepitaxial seed layer applications.

Further optimization of the electron beam evaporation process is necessary to produce more coalesced Si films with a uniform Si(111) orientation. However, initial results suggest that electron beam evaporation may be a more promising approach than sputtering for AIC-Si thin film fabrication.

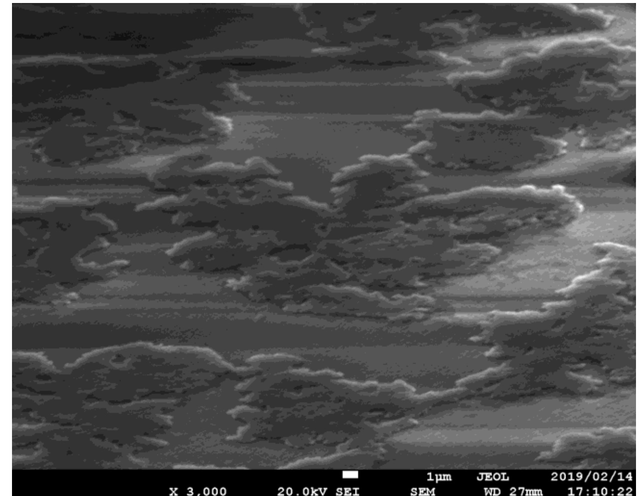

Fig. 1 Smooth surface of Si islands formed by AIC from films fabricated with e-beam evaporation.

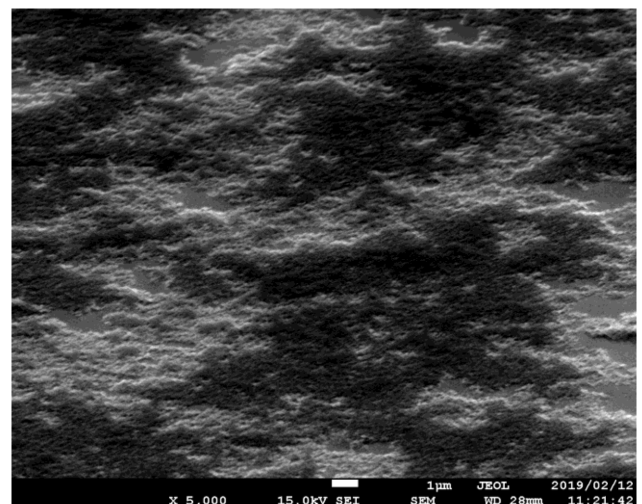

Fig. 2 Rougher surface of Si islands formed by AIC from films fabricated by DC sputtering.

4. その他・特記事項（Others）

Funding provided by JSPS Postdoctoral Fellowship (F17366)

5. 論文・学会発表（Publication/Presentation）

None

6. 関連特許（Patent）

None