

Pole figures as tools for understanding film misorientation in Group IV thin films fabricated by aluminum-induced crystallization

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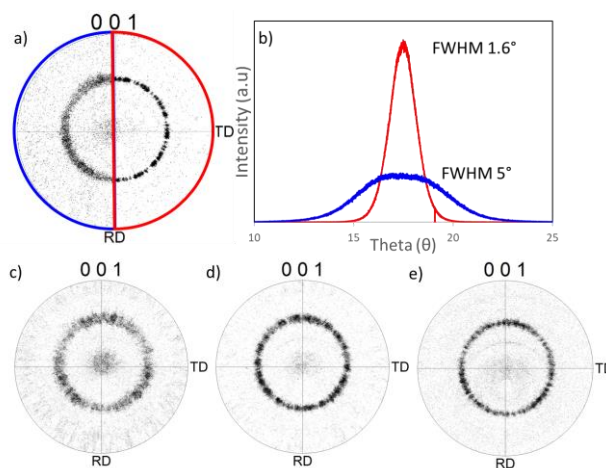
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Si and Ge(111) films with >95% surface orientation fabricated by aluminum-induced crystallization have been realized in recent years. These substrates are attractive for subsequent homo-and heteroepitaxy, but the standard characterization methods for these films do not give clear information about the suitability of the surfaces for subsequent epitaxy. Here, we discuss how analysis of pole figures from electron backscatter diffraction (EBSD) can give a qualitative but clear evaluation of the misorientation of AIC-Si films and their suitability for subsequent homo or heteroepitaxy.

AIC-Si films were fabricated by depositing ~30nm of Al onto fused quartz substrates. Following a brief air exposure, ~30nm of amorphous silicon was deposited. Subsequent annealing at temperatures from 425-500°C formed crystalline silicon thin films. For some samples, aluminum was etched prior to EBSD, while for other samples the aluminum was removed and then MOCVD growth of GaN was performed.

As can be seen in Figure 1a, – EBSD pole figures illustrate clear differences in film quality for samples annealed at the same temperature but with different degrees of misorientation. Subsequent x-ray rocking curves (Figure 1b) of GaN films grown on these substrates show how the degree of AIC-Si misorientation translates to tilt in the heteroepitaxial GaN layer. Figure 1c-e illustrates the evolution of the AIC-Si pole figure with annealing temperature, showing that the pole figure transforms from a diffuse ring to a sharp band as annealing temperatures decrease from 500 to 425°C. Thus through use of the EBSD pole figure, the effect of fabrications on AIC film quality can be observed and conditions can be subsequently optimized.

Figure 1 – a) EBSD pole figures of AIC-Si films annealed at identical temperatures with different film quality. b) X-ray rocking curves showing the effect of different film quality on GaN misorientation. c-e) Pole figures of AIC-Si films annealed at 500°C, 450°C, and 425°C.



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