Impact of Grain Boundary Interactions on Grain Structure of Multicrystalline Silicon

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[Introduction] Multicrystalline silicon (mc-Si) is the dominant material for solar cells and recently high performance mc-Si (HP mc-Si) has gained attention. In HP mc-Si, grains grow from small randomly oriented seeds and grain size increases with growth [1]. This means grain structure is evolving with growth, however this evolution mechanism is unclear. In this study we investigated how grain boundary (GB) interactions affect the grain structure evolution in mc-Si grown from small randomly oriented grains.

[Experimental] We grew mc-Si from a microcrystalline template by directional solidification. The ingot was cut into vertical and horizontal wafers, which were analyzed using electron backscatter diffraction (EBSD). GB interactions that increase GB density was defined as **Generation.**

[Results]The result for Generation, shown in Fig.1 (a), statistically identifies that Σ3 GB generation interaction is dominant, especially at later growth stage. We also discovered that when Σ3 GB was generated from R GB, the R GB inclined as shown in Fig. 1.(b) (Circles in vertical wafer). This is expected to increase grain size so we examined it also in horizontal wafers from different growth heights as shown in Fig. 1 (b) (Horizontal Wafers). It is clear that twinned grains grow larger with growth in comparison to other grains.

[Conclusion] We have statistically demonstrated that Σ3 GB interaction is dominant and it contributes to grain size increase in mc-Si grown from small randomly oriented grains.

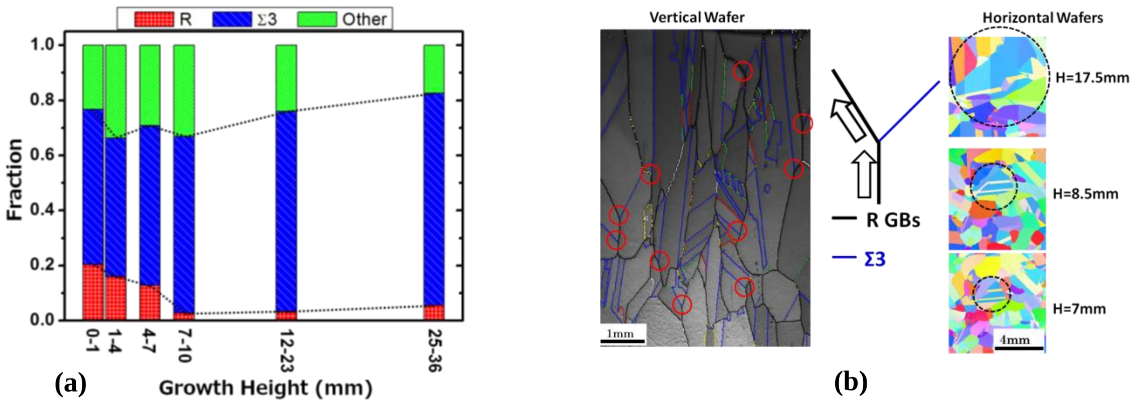

Figure 1. (a) Statistics of GB Generation interactions. b) (Left) Image of vertical wafer showing grain boundary interactions, (Right) Inverse pole figures of horizontal wafers showing twinned grain enlargement.

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