Formation of Large-grain polycrystalline Si Layer on Quartz

by Al-induced Crystallization for Thin-Film Solar Cells

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Aluminum-induced crystallization (AIC) have been intensively investigated as one of the alternative for low temperature post-crystallization Si [1]. Several groups have already reported the fabrication of AIC-based Si thin film solar cells. However, the efficiency is much lower than that for conventional wafer Si solar cells. Therefore, the intrinsic crystalline qualities of AIC poly-Si such as grain size and crystal-orientations have to be optimized. In this study, we optimized the growth parameters of poly-Si seed layer formation on quartz substrates. Furthermore, solid phase epitaxy (SPE) on AIC seed layer was investigated to form thicker crystalline Si layer.

The a-Si/Al/quartz sample stack was annealed to induce the crystallization. The Al and a-Si layer (Al/a-Si ratio 1:1.25) were deposited by sputtering. The Al layer was exposed to air for 48 hours prior to a-Si deposition. The optimization was done by changing the initial sample thickness and annealing temperatures. The sample crystallinity was characterized by electron backscatter diffraction (EBSD). Then, a-Si layer with 1µm was deposited on AIC poly-Si. The thicker epitaxial layer was formed by rapid thermal annealing (RTA) via SPE process. The Si SPE film was characterized by UV-Vis measurement. The crystalline quality Q was estimated by equation:

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Q = \frac{1}{2} \left[ \frac{R_{e1}}{R_{e1}+R_{e2}} + \frac{R_{e2}}{R_{e1}+R_{e2}} \right] \times 100\%
\]

The data of reflectance measurement showed higher Q of ~82 %, when 50nm AIC poly-Si used as seed layer (Figure 3).

Figure 1. EBSD of poly-Si by varied Al-thickness and annealed at 425°C for 100h

Figure 2. EBSD of 50nm AIC poly-Si annealed at various temperature

Figure 3. UV reflectance of SPE on AIC poly-Si annealed 100°C for 30min in by RTA