Formation of polycrystalline Silicon Layer on Quartz substrate by Aluminium-induced Crystallization

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Aluminium-induced crystallization (AIC) is the promising technique to obtain the poly-crystalline Si film on top of foreign substrate [1-2]. However, relatively high Al contamination of poly-Si AIC causes its electronic property seems not sufficient for photovoltaic absorber application [2]. So far, the most promising application of AIC poly-Si is seems as the seeding layer for Si layer epitaxy. It is supported by fact that AIC can induce the (100) orientation poly-Si layer which is the best orientation for epitaxial growth of Si. Furthermore, grain size of poly-Si layer formed by AIC can exceed 10μm [2]. In this study we investigated the optimal AIC condition for the formation of poly-Si layer on quartz substrate.

The experimental procedure is shown in Figure 1. We varied the annealing temperature, Al layer thickness and the a-Si/Al thickness ratio. The layer exchange and surface image of poly-Si was investigated by scanning electron microscopy (SEM). The crystallinity was confirmed by Raman spectroscopy. The orientation of poly-Si layer was investigated using electron back scattering diffraction (EBSD).

By optimizing the layer thickness and annealing time, the continuous poly-Si layer can be obtained on the quartz substrate, although some Si-particles are existing. The a-Si/Al ratio significantly affects the continuity of poly-Si AIC. The best a-Si/Al ratio was obtained between 1.0-1.5. Raman spectroscopy revealed that poly-crystalline Si is obtained after AIC. From Figure 2, it can be shown the position of Si optical phonon peak shifted to lower frequency. The shift is probably caused by the phonon confinement effect and tensile stress. We also obtain two different preferential orientation where (100) orientation is preferable in 200 nm Al layer thickness, while (111) orientation in 100 nm as shown in Figure 3.

References: [1] N. P. Harder, et al., IEEE (2000) 351. [2] O. Nast, et al., J. App. Phys. 88(2000) 124.

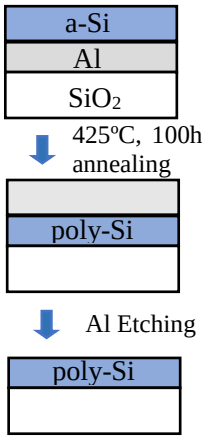


Fig. 1. Experimental scheme

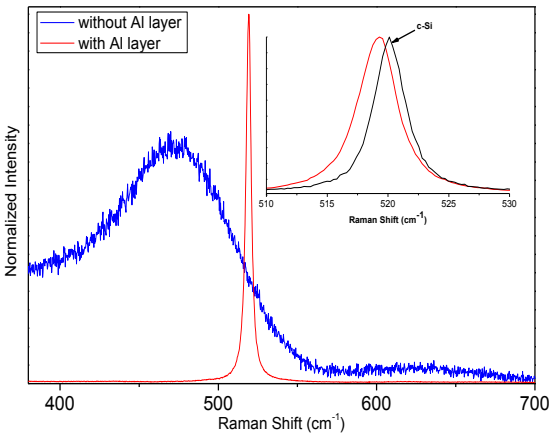
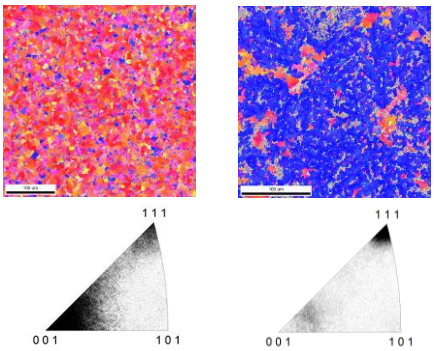


Fig. 2. Raman Spectra of AIC poly-Si



(a) 200nm Al (b) 100nm Al

Fig. 3. Mapping and IPF EBSD