Supplementary Information

Control of grain size and crystallinity of poly-Si film on quartz by Al-induced crystallization

Junyi Chen [a, b], Joko Suwardy [a, b], Thiyagu Subramani [a,*], Wipakorn Jevasuwan [a], Toshiaki Takei [a], Kaoru Toko [b], Takeshi Suemasu [b], and Naoki Fukata [a, b,*]

[a]International Center for Materials Nanoarchitectonics, National Institute for Materials Science, Tsukuba, Ibaraki, 305-0044, Japan
[b]Institute of Applied Physics, University of Tsukuba, Tsukuba, Ibaraki 305-8573, Japan

1. Characterization of Al content in AIC poly-Si samples

Energy dispersive X-ray spectroscopy (EDX) was conducted to investigate the Al content in AIC poly-Si samples. The measurements were done for 100 nm poly-Si samples. The annealing was done at 425 ˚C for 100 hours. After removing the Al layer, the samples were measured by EDX at 20 kV. The result was shown in Figure S1. EDX peaks related to Si, oxygen (O) and carbon (C) were observed at 1.739 keV, 0.525 keV and 0.277 keV respectively. No Al related peaks were detected, indicating that the Al removal was successfully done by wet chemical etching processes. It also indicates the Al concentration in our sample is lower than the limitation of EDX detection.

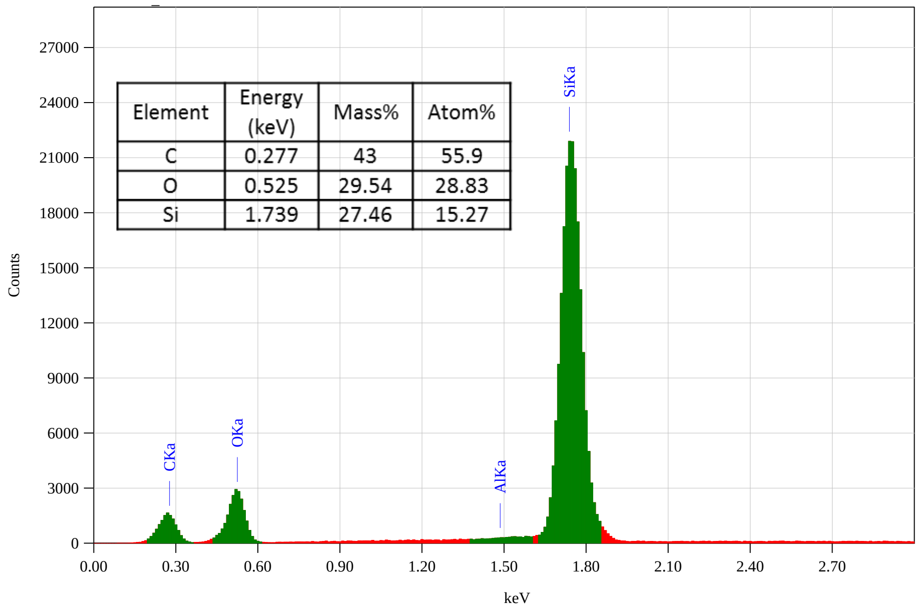

Figure S1: An EDX spectrum of 100 nm poly-Si annealed at 425 ˚C for 100 h.

2. Electrical properties of AIC poly-Si samples

Considering the future devices applications, it is important to investigate the electronic properties of AIC poly-Si samples. Therefore, Hall measurements were conducted for AIC poly-Si with different thickness of 50 nm, 100 nm and 200 nm. These samples are annealed at 425 ˚C for 100 hours for the AIC process. The result of Hall measurement is summarized in table S1. The carrier density (*n*) of our samples was in the range of 10^{18}-10^{19} cm^{-3}. Table S1 shows the increasing trends of resistivity and mobility with increasing the poly-Si thickness. The high carrier concentration is due to the Al residue in AIC poly-Si. Even though the electrical properties was low for Si thin-film cells but good structural property is still promising to be applied for seeding layer.

Table S1. Electrical properties of AIC poly-Si samples with different thickness

Thickness (nm)	Carrier density (cm^{-3})	Mobility cm^2/Vs
50	3.2×10^{18}	17.1
100	2.5×10^{18}	30.4
200	4.7×10^{17}	41.7

3. Surface roughness of substrate

The surface roughness of Al layers is strongly linked to substrate roughness. Lower surface roughness leads to a smoother Al surface, which is useful for achieving larger poly-Si grains. The surface condition of AIC poly-Si can be an important factor when applying AIC poly-Si to the seed layer. Figure S3 shows a comparison of AIC poly-Si surfaces grown on two kind of substrates: polished quartz and frosted quartz. We can see that the frosted quartz, which has a more rugged surface, leads to a rougher poly-Si surface. This result suggests the importance of substrate selection in order to form smooth poly-Si film.

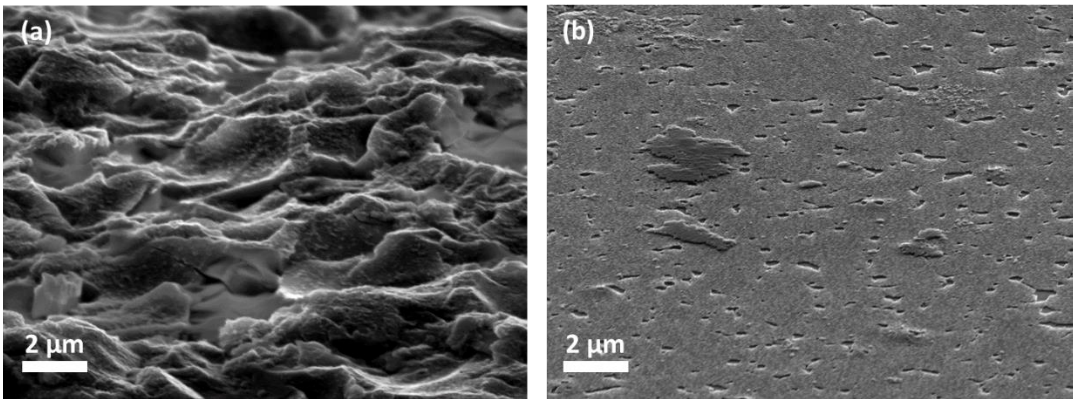

Figure S3: SEM images of AIC poly-Si surface with initial sample of 60-nm a-Si/50-nm Al/quartz, air exposure for 48 hours, annealed at 425 ˚C for 100 hours on (a) frosted-quartz and (b) polished quartz substrate.