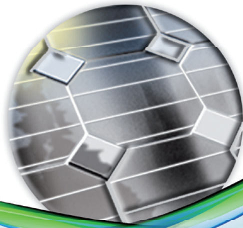

Photovoltaics

Cathodoluminescence

CL27

Electrical and optical properties of the small-angle grain boundaries (SA-GBs) in multicrystalline Silicon for solar cell

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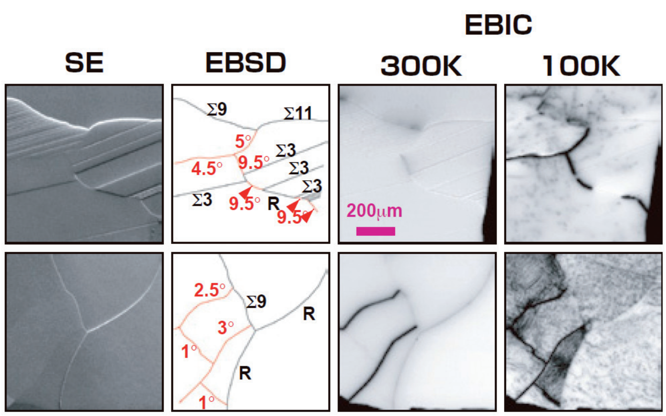
The electrical and optical properties of small-angle grain boundaries (SA-GBs) which can reduce the conversion efficiency in multicrystallin silicon (mc-Si) solar cell were clarified by a combination of electron-beam-induced current (EBIC) and Cathodoluminescence (CL) investigations. High pure mc-Si was used to avoid the effect of the contamination. EBIC observation, SA-GB with a misorientation angle of around 1° showed no obvious contrast (<10%) at room temperature (300K), while the strong contrast of 25-50% was observed at low temperature (100K). And the SA-GB of around 2° showed the strong contrast even at 300K . Based on these results, it is suggested that the former possesses the only shallow energy levels and the latter has possesses the both shallow and deep levels. According to the monochromatic CL images, D3 and D4 emissions were chiefly observed at the SA-GBs of 1° SA-GBs of 2° and 2.5° .These results can be explained by the difference of the dislocation density on GBs. And it should be noted that D1 emissions were observed at the broad area around the SA-GBs. On the other hand, large-angle Σ and random show week EBIC contrast at 100K\ and no emission was observed.

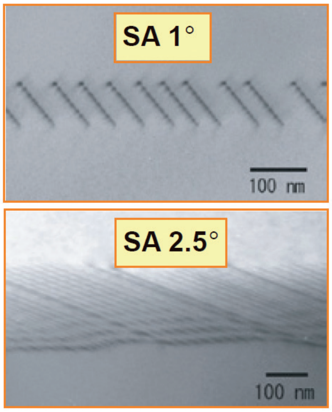
In summary, it was found that SA and large-angle GBs were essentially different electrical and optical properties and especially SA-GBs will be electrically fatal defects. To improve the conversion efficiency in mc-Si solar cell, it is important to control SA-GBs.

EBIC/Electric property



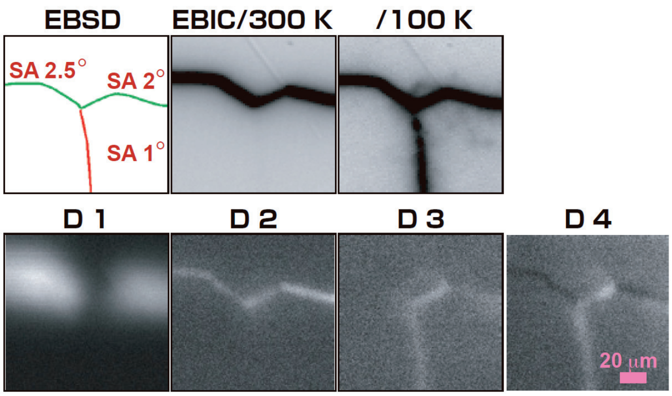
The SA-GBs of around 2° are electrically active at 300K and 100K, while the Sa-GBs except 2° and large-angle Gbs (**Σ** and random) is are active at only 100K.

TEM/Stucture observation



The SA-GB is composed of an array of individual edge dislocations. The dislocation density is inverse proportion to the misorientation angle.

CL/Optical property

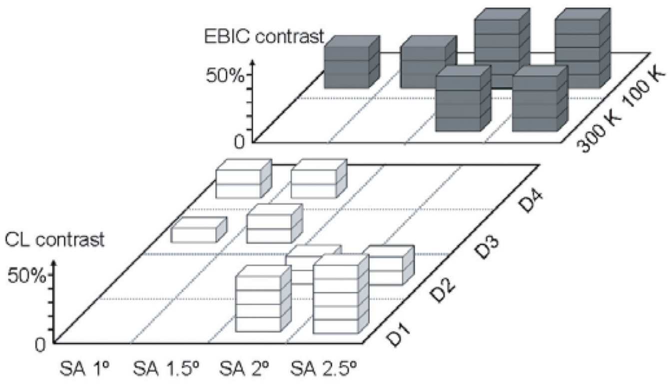


D1 and D2 can be are observed at SA 2°and 2.5°, and while D3 and D4 are observed at SA1°

Summary

The electrical and optical properties of SA-GBs can be explained by the dislocation density of GBs. The SA-GB of around 1° reflects the properties of the isolated dislocation, and that of around 2° is considered that the interaction of dislocations occurred.

The relation between EBIC and CL



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