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Letter to the Editor

Comment on "Analysis of the High Conversion Efficiencies β-$FeSi_2$ and $BaSi_2$ n-i-p Thin Film Solar Cells"

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A recent report, titled "Analysis of the High Conversion Efficiencies β-$FeSi_2$ and $BaSi_2$ n-i-p Thin Film Solar Cells," brings a significant anticipation to silicon-based solar cells, due to the unexpected high conversion efficiency of 30.4% [1]. This extremely high expectation may expedite the Si solar cells for broad applications according to the excellent solar power generation with a light-weight thin film structures.

The silicides are compounds of silicon and metals, which have a high compatibility to the current Si technology [2, 3]. Ni silicide nanowires were applied for nanoscale contacts, field emitters, and functional microscopy tips. Due to the tiny size with an excellent electrical conductivity, metal silicide materials would open a new era for Si electronics. Ni silicide may induce the nanowire formation by modulating the Si supply, Ni thickness controls, or heating temperature. Among the various features, metal silicide nanowires can be grown mainly by the property of metal diffusion into the Si material. Fast Ni diffusion brings the Ni silicide nanowires but slow Co diffusion forms the uniform Co silicide film. Pd diffusion is mediocre to grow thick microscale pillar formation [4].

For metal silicide-mediated Si solar cells, Ni and Co are excellent materials to Si due to a little discrepancy. However, fast Ni diffusion readily causes Ni atomic impingement into the Si material, resulting in the broken junction formation [5], similar problem occurred as stacking fault by manganese silicides [6], various formations of iron silicides [7], and barium silicides [8].

Solar cells, including all photoelectric devices, ensure the rectifying junction formation where a high electric field exists to separate the photogenerated carriers. Otherwise, an ohmic contact just renders high current flows without forming a space charge region (or depletion region), resulting in no photovoltaic effects.

According to the structure of β-$FeSi_2$ and $BaSi_2$ n-i-p thin film solar cells, two depletion regions are formed in the junction between n-Si and $BaSi_2$ (or $FeSi_2$) and between $BaSi_2$ (or $FeSi_2$) and p-Si. The energy bandgap of $BaSi_2$ or $FeSi_2$ is extremely desirable to Si materials [9]; however, the metal diffusion may cause a serious concern for rectifying junction formation. From the calculation, a clear formation of depletion layer was assumed; however, practical approaches highly require the clearance of metal diffusion in the Si layers. The expected higher fill factor values (above 82%) can be realized on the efficient control of metal diffusion into Si layer. If the authors will provide the simulation for metal diffusion effect to establish silicide layer-embedding Si solar cell, a significant manipulation can be performed to realize the high-efficient metal silicide-assisted Si solar cells.

Conflict of Interests

The authors declare that there is no conflict of interests of commercial or financial relationships.

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