Development of tunnel junctions for c-Si/perovskite tandem solar cells : A way forward

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Abstract

Reduction in fabrication cost of silicon solar cell modules has driven the photovoltaics industry for several decades. An important factor on which this cost reduction relies is improvement in cell efficiency. With the crystalline silicon based single junction devices maxing out at 29.4% due to different physical loss mechanisms, tandem devices with a maximum efficiency potential of ~43% have been proposed. Recent efforts of research community have been devoted to develop Si based tandem devices with silicon cell at bottom and perovskites [1-3], III-V alloys [4], etc. at top. In fact, monolithic perovskite/silicon tandem solar cells have already surpassed the silicon and perovskite single junction record efficiencies with 29.15% [3]. With this silicon tunnel junctions have developed a renewed interest for bottom cell fabrication.

Silicon tunnel junctions were previously fabricated by various techniques such as molecular beam epitaxy, liquid phase epitaxy, ion implantation, thermal annealing of doping solutions, etc. In this work, we use plasma enhanced CVD (PECVD) as an effective method to grow low-temperature epitaxial silicon (both n^{++} and p^{++}) for developing silicon tunnel junctions [5]. The samples are analyzed using optical and electrical characterizations including, UV-visible spectroscopic ellipsometry, FTIR, Raman spectroscopy, effective lifetime measurements, and J(V) characteristics.

References

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