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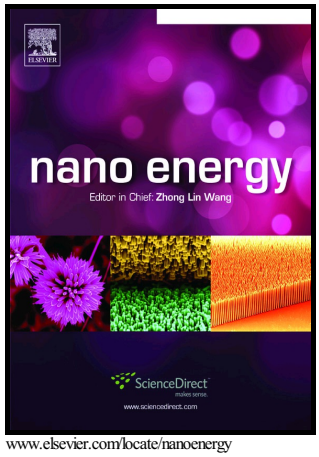

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PII: S2211-2855(18)30600-1
DOI: https://doi.org/10.1016/j.nanoen.2018.08.038
Reference: NANOEN2968

To appear in: *Nano Energy*

Received date: 28 April 2018
Revised date: 17 August 2018
Accepted date: 17 August 2018

Cite this article as: Xiaolin Sun, Ting Zhang, Junzhuan Wang, Fan Yang, Ling Xu, Jun Xu, Yi Shi, Kunji Chen, Pere Roca i Cabarrocas and Linwei Yu, Firmly standing three-dimensional radial junctions on soft aluminum foils enable extremely low cost flexible thin film solar cells with very high power-to-weight performance, *Nano Energy,* https://doi.org/10.1016/j.nanoen.2018.08.038

Firmly standing three-dimensional radial junctions on soft aluminum foils enable extremely low cost flexible thin film solar cells with very high power-to-weight performance

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Abstract:

Flexibility and power-to-weight (PTW) ratio are the key factors for promoting wearable or portable solar cell applications. Planar hydrogenated amorphous silicon (a-Si:H) thin films deposited directly on soft aluminum foils (AF) are usually subject to easy cracking and delamination due to the mechanical instability on AF surface. Here, an exceptionally robust three-dimensional (3D) construction of a-Si:H radial p-i-n junction solar cells on soft supermarket-available AF of 15 μm thick is reported, where the discrete and firmly standing Si nanowire (SiNW) cores, grown and rooted on the soft AF surface, frame up a 3D architecture that protects the protrusive photo-active radial junctions from the unstable a-Si/Al bottom layer. An excellent flexibility and integrity of the 3D a-Si:H radial junctions have been achieved, even under bending to radius of 5 mm. Remarkably, without any diffusion barrier protection, a power conversion efficiency of 5.6% has been recorded, with an open-circuit voltage of 0.71 V and photo-current density of 14.2 mA/cm^2, leading to a high PTW ratio of >1300 W/kg. Importantly, the overall fabrication cost can be largely slashed off, by ~46% compared to conventional a-Si:H solar cells, as the need for a bottom TCO contact/texturing layer, for a back-reflection coating and for a glass/polymer substrate are all exempted.

Graphical abstract: