Supplementary materials for

Increasing Efficiency of Hierarchical Nanostructured Heterojunction Solar Cells to 16.3% *via* Controlling Interface Recombination

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Table S1. Overview the efficiency of Si heterojunction nanostructure solar cells

Institute	V_{oc} *(mV)*	J_{sc} *(mA/cm²)*	*FF (%)*	*Eff (%)*	*Year*
General Electric-Global Research Center, New York	0.13	1.6	28	0.058	2007 [1]
Harvard University, Cambridge	0.26	N/A	55	3.4	2007 [2]
University of California, Berkeley	0.29	4.28	33	0.46	2008 [3]
The Pennsylvania State University	0.5	7.6	57	2.3	2010 [4]
Hanyang University	0.52	17.67	71.36	6.56	2010 [5]
Cornell University	0.59	26.4	69	10.8	2010 [6]
Stanford University	0.58	29.2	64.9	11	2011 [7]
University of California, Berkeley	0.59	31.1	66.4	12.2	2012 [8]
University of Texas at San Antonio	0.53	29.5	61.2	9.6	2013 [9]
Institute of Photonic Technology	0.53	26.46	73.4	10.0	2013 [10]
National Taiwan University	0.596	36.58	69.5	15.1	2013 [11]
Delft University of Technology	0.5	35.1	67	11.8	2014 [12]
Nankai University*	**0.611**	**37.1**	**71.7**	**16.3**	**2015**

**** This work***
(Special interface engineering for solar cells)

Reference

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Details of PECVD process parameters

Table S2. RF-PECVD system conditions for hydrogen plasma pre-treatment and i-a-Si:H films.

Process	T_{dep} (°C)	H_2 (sccm)	SiH_4 (sccm)	**Power density** (mW/cm^2)	**Pressure** (Torr)
H_2-plasma treatment	140	50	-	8	2.2
i-a-Si:H	140	50	20	25	1

Table S3. Conditions for depositing the p- and n-type doped layer.

Layer	P (mW/cm^2)	T_{dep} (°C)	SiH_4 (sccm)	TMB (sccm)	PH_3 (sccm)	H_2 (sccm)	p (Torr)
p-a-Si:H	53	180	1	2	-	120	2
n-a-Si:H	53	180	2	-	2.5	180	1.3

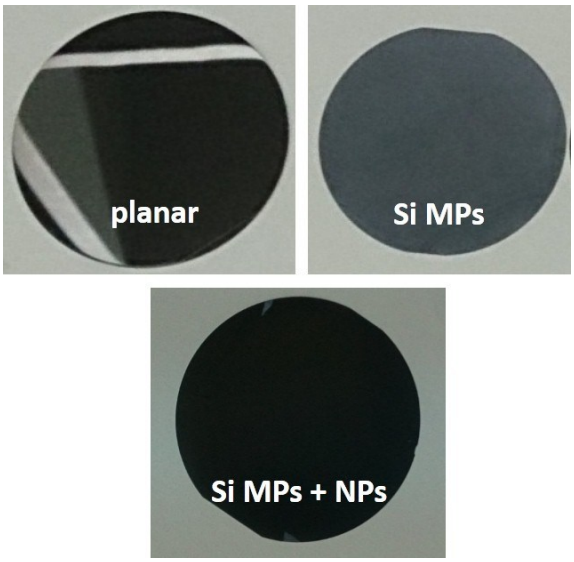

Fig. S1. Photographic image of structures planar, Si MPs, and Si MPs + NPs structure substrates.

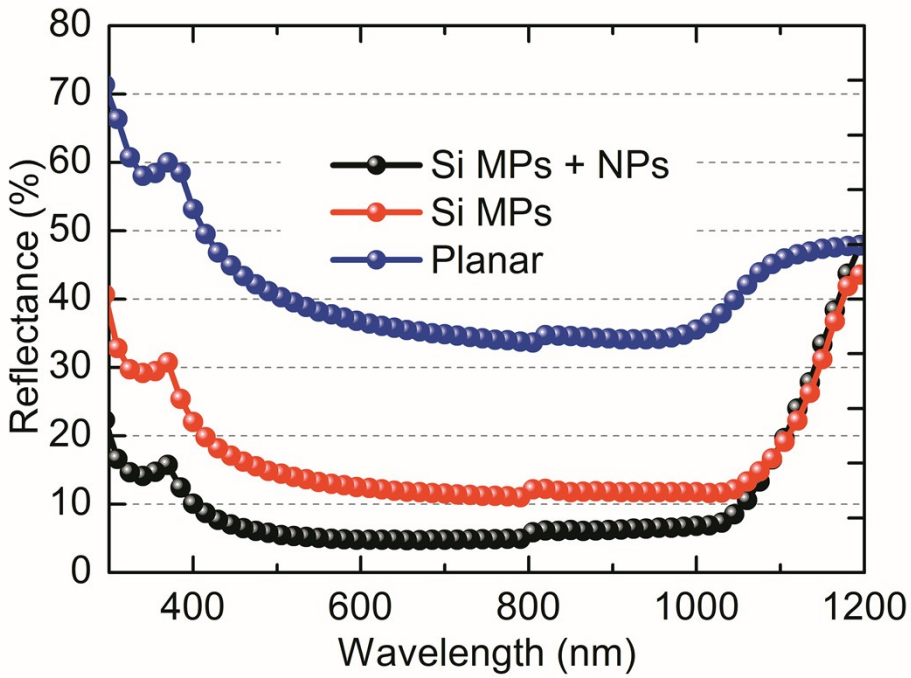

Fig. S2. Total reflectance spectra of planar, Si MPs, and Si MPs + NPs structure substrates.

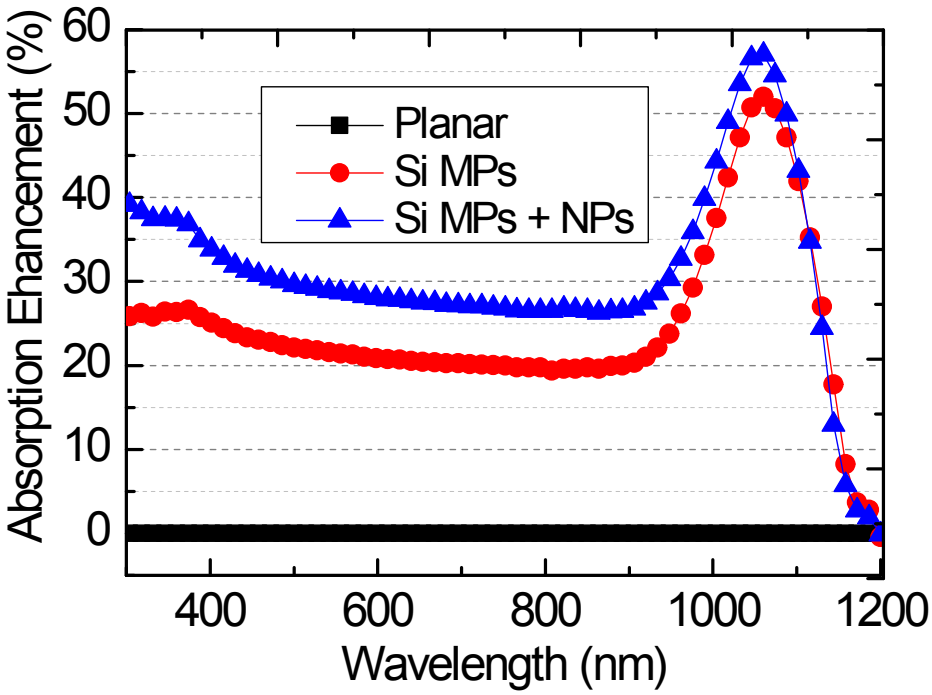

Fig. S3. The absorption enhancement for Si MPs and Si MPs + NPs substrates, compared with planar substrate.

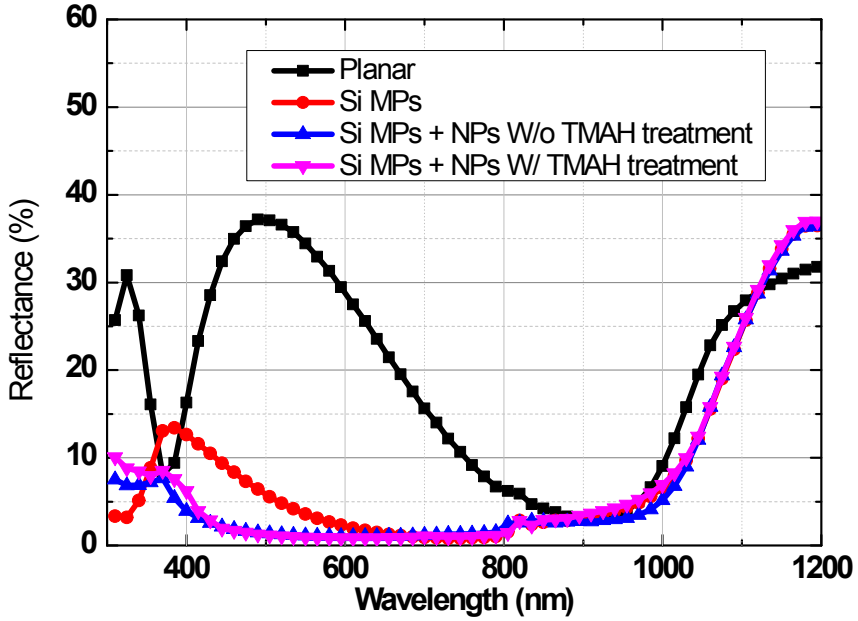

Fig. S4. The total reflectance of the heterojunction solar cells based on Planar, Si MPs, Si MPs + NPs with treatment, and Si MPs + NPs without treatment substrates.