Improving the performance of direct bonded 5-junction solar cells by optimization of AlInP window layer

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Supplementary Information

		n-GaAs substrate	350μm
		etch stop	100nm
	1×10^{19} cm^{-3}	n-GaAs contact	300nm
top cell	7×10^{18} cm^{-3}	n-$Al_{0.5}In_{0.5}P$ window	30nm
	3×10^{18} cm^{-3}	n-$Al_{0.18}Ga_{0.33}In_{0.49}P$ emitter	20nm
	5×10^{16} cm^{-3}	p-$Al_{0.18}Ga_{0.33}In_{0.49}P$ base	450nm
	5×10^{17} cm^{-3}	p-$Al_{0.31}Ga_{0.2}In_{0.49}P$ BSF	100nm
		$Al_{0.3}Ga_{0.7}As/Al_{0.18}Ga_{0.33}In_{0.49}P$ TJ	30nm
mid cell		$Al_{0.23}Ga_{0.77}As$ subcell	1200nm
		$Al_{0.3}Ga_{0.7}As/Al_{0.05}Ga_{0.46}In_{0.49}P$ TJ	30nm
	6×10^{18} cm^{-3}	n-$Al_{0.5}In_{0.5}P$ window	120nm
	2×10^{18} cm^{-3}	n-GaAs emitter	100nm
bottom cell	1×10^{17} cm^{-3}	p-GaAs base	3500nm
	5×10^{17} cm^{-3}	p-$Al_{0.16}Ga_{0.84}As$ BSF	20nm
	2×10^{19} cm^{-3}	p-GaAs bonding	50nm

Figure S1. Detailed cross-section structure of inverted GaAs T-3J sub-cell. The active region of each sub-cell consists of n-on-p junction (emitter/base) surrounded by n-type window layer and p-type BSF layer.

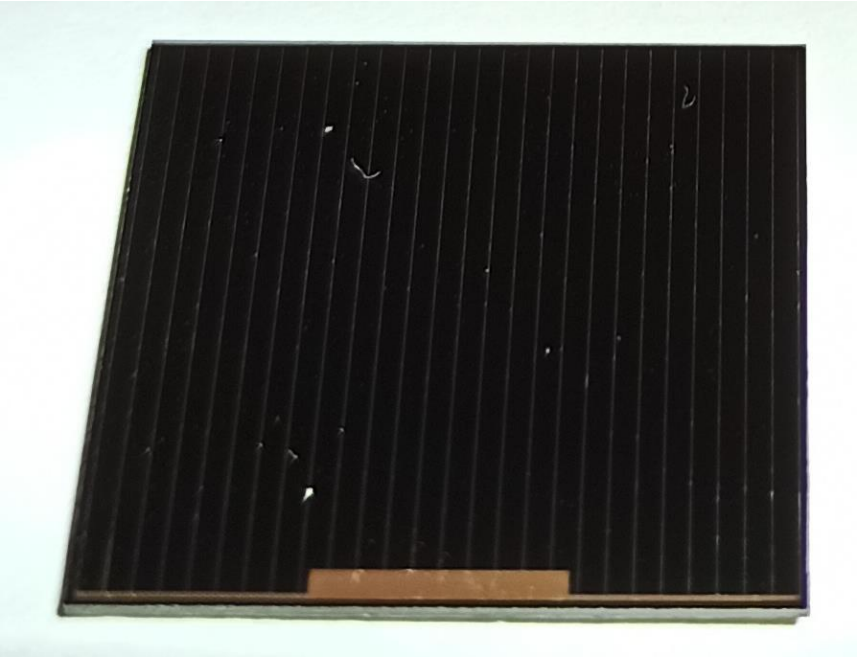

Figure S2. Photo of fabricated 2.0 × 2.0 cm^2 5J solar cell device.

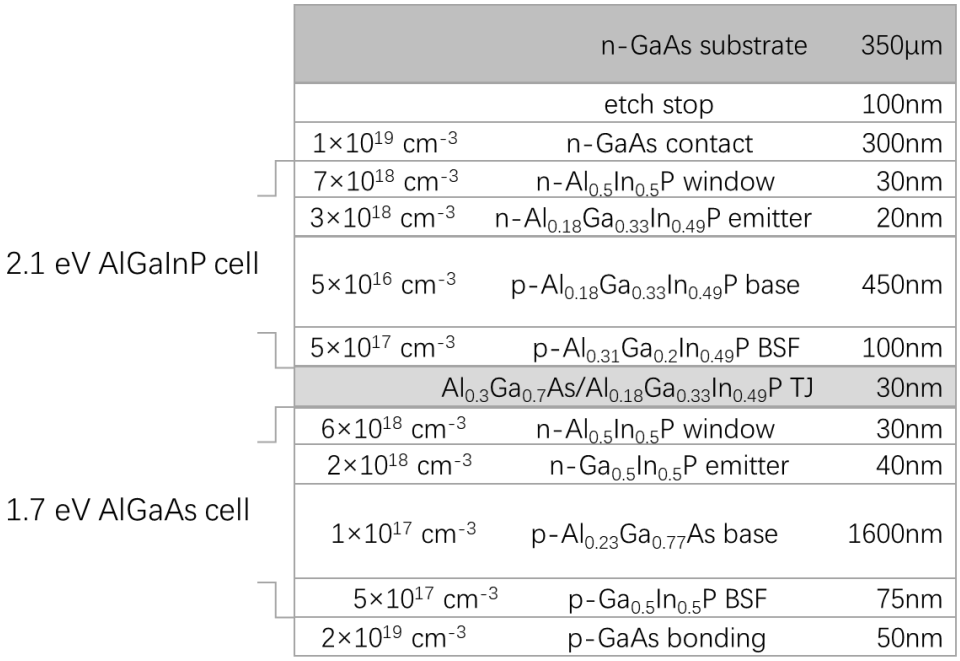

Figure S3. Schematic cross-section structure of inverted AlGaInP/AlGaAs dual-junction solar cell. The 1.7 eV AlGaAs sub-cell is 400 nm thicker than T-3J structure to absorb enough light and make AlGaInP sub-cell current-limiting.