

(a)

Contact	<i>n</i> -GaAsP	125 nm
Window	<i>n</i> -AlInP	20 nm
Emitter	<i>n</i> -GaAsP	50 nm
	UID-GaAsP	300 nm
Base	<i>p</i> -GaAsP	400 nm
w/o or w/ DBR		
Etch stop	<i>p</i> -GaInP	30 nm
LCL	<i>p</i> -GaAs	250 nm
Graded buffer		
	<i>p</i> -GaAs _y P _{1-y}	1.8 μm
Buffer	<i>p</i> -GaP	500 nm
Nucleation	<i>n</i> -GaP	50 nm
Substrate	UID/ <i>p</i> -Si	750 μm

(b) w/o DBR (baseline)

BSF	<i>p</i> -Al _{0.34} GaAsP	50 nm
Spacer	<i>p</i> -GaAsP	400 nm

(c) w/ DBR (DBR cell)

DBR1	<i>p</i> -Al _{0.20} GaAsP	49 nm
DBR2	<i>p</i> -Al _{0.80} GaAsP	57 nm
19× :		
DBR41	<i>p</i> -Al _{0.20} GaAsP	49 nm

Fig. 1. Schematic of (a) GaAsP single-junction (1J) solar cells with either (b) a spacer and back surface field (BSF) layer or (c) an AlGaAsP distributed Bragg reflector (DBR) below the absorber to enhance photon absorption.

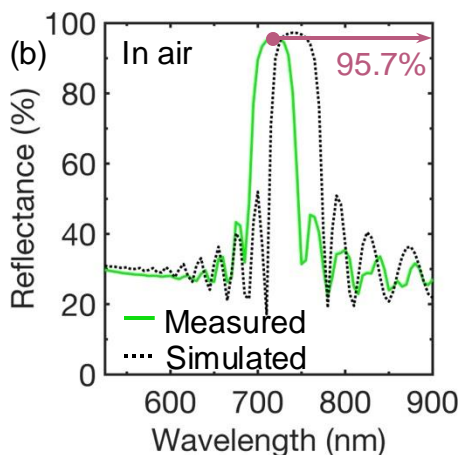
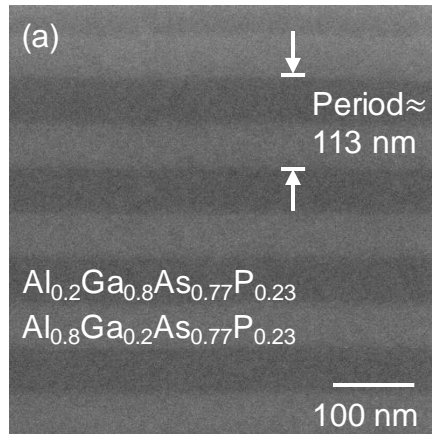


Fig. 2. (a) Cross-sectional SEM and (b) measured vs. simulated reflectance of an AlGaAsP DBR-only calibration growth. ~25nm shift in the central wavelength, due to interpolation errors in refractive index modeling, was corrected in the device growth.

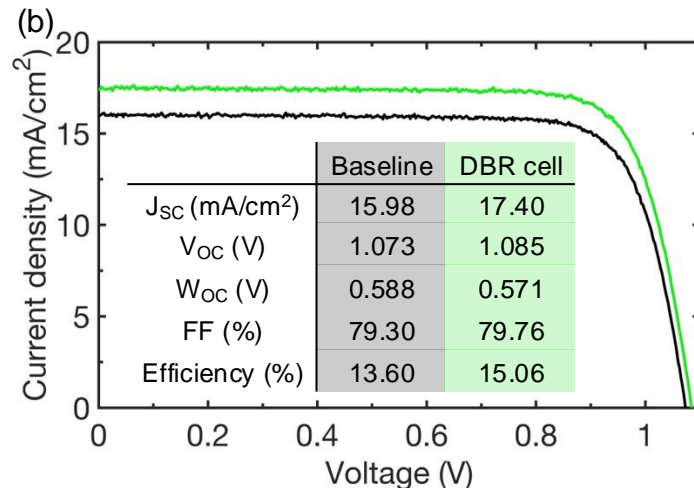
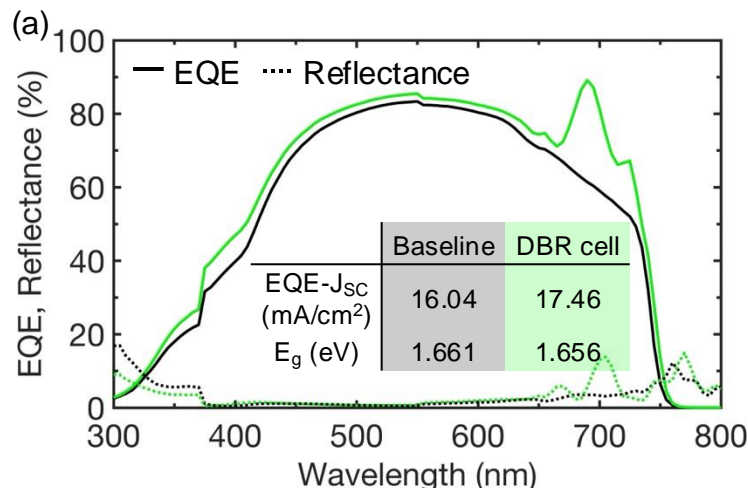
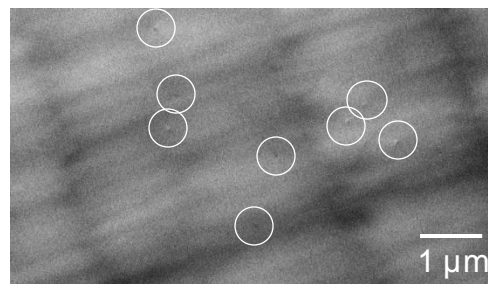
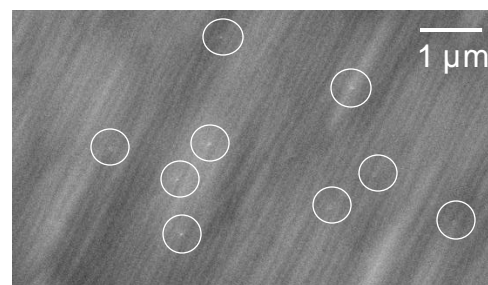


Fig. 4. (a) External quantum efficiency (EQE) and reflectance spectra, and (b) lighted current-voltage characteristics of GaAsP solar cells with and without an AlGaAsP DBR. The DBR significantly improves carrier collection at long wavelengths, increasing EQE-J_{sc} by 1.42 mA/cm². Increased J_{sc}, along with a 12 mV V_{oc} gain, drives a 1.46% absolute efficiency increase compared to the baseline cell.

(a) Baseline; TDD=7±3×10⁶ cm⁻²



(b) DBR-only; TDD=8±2×10⁶ cm⁻²



(c) DBR cell; TDD=8±3×10⁶ cm⁻²

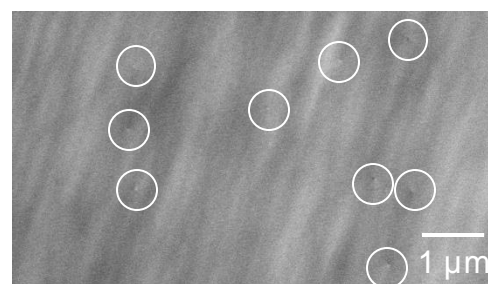


Fig. 3. ECCI micrographs of (a) GaAsP 1J baseline, (b) DBR-only calibration, and (c) GaAsP 1J DBR cell, with white circles denoting threading dislocations (TDs). All cells show similar TDD (≤8×10⁷ cm⁻²), confirming that the DBR does not introduce additional TDs.