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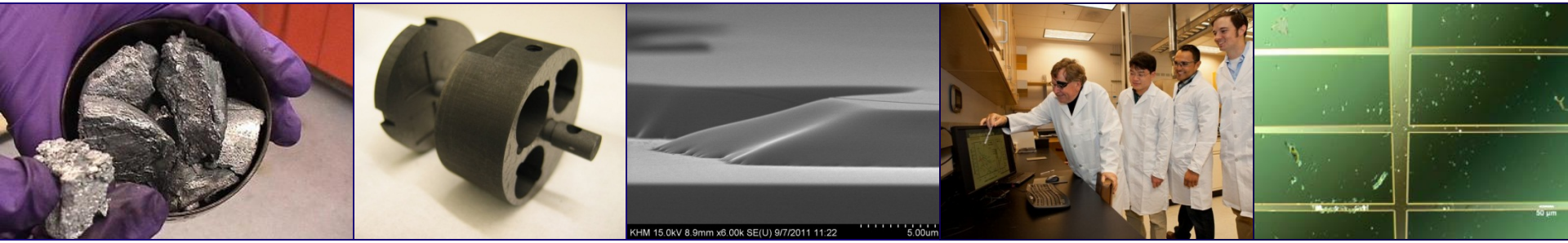

Enhanced Schottky Contacts using an MIS Structure for Photovoltaic and Other Device Applications

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Background

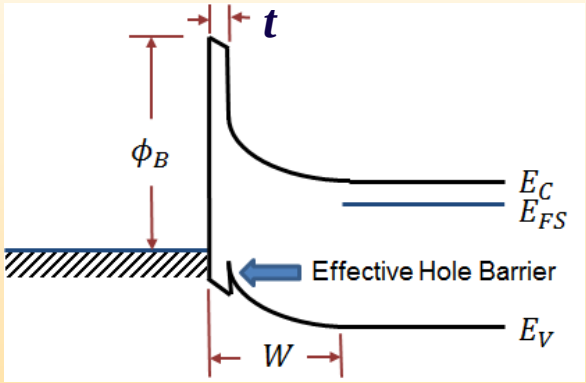
- Majority carrier current (thermionic):

$$J_{0e} = A^* T^2 e^{-q\phi_B/kT}\left(e^{qV_A/kT} - 1\right)$$

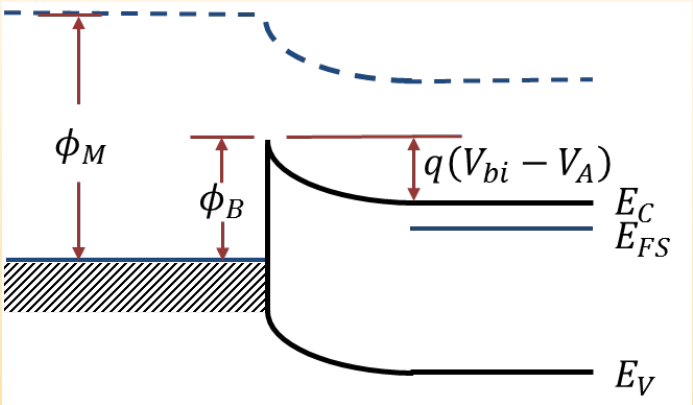
- Minority carrier injection current:

$$J_{0h} = \frac{qD_P {n_i}^2}{L_P N_D}\left(e^{qV_A/kT} - 1\right)$$

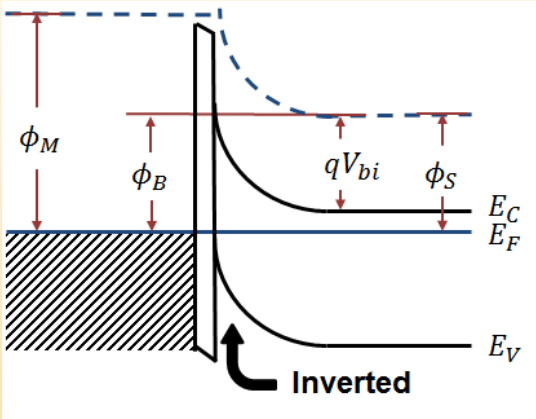
- Majority carrier component is dominant! $J_{0e} \gg J_{0h}$



Heterojunction (Forward Bias)



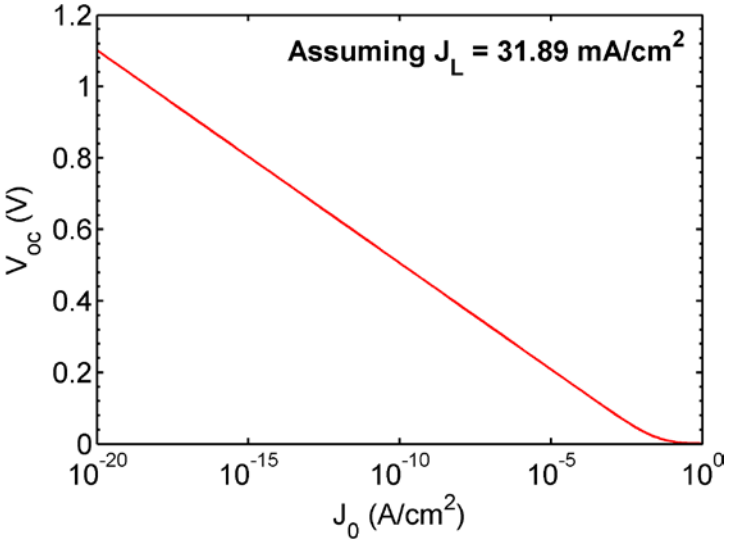
MS Junction (Forward Bias)

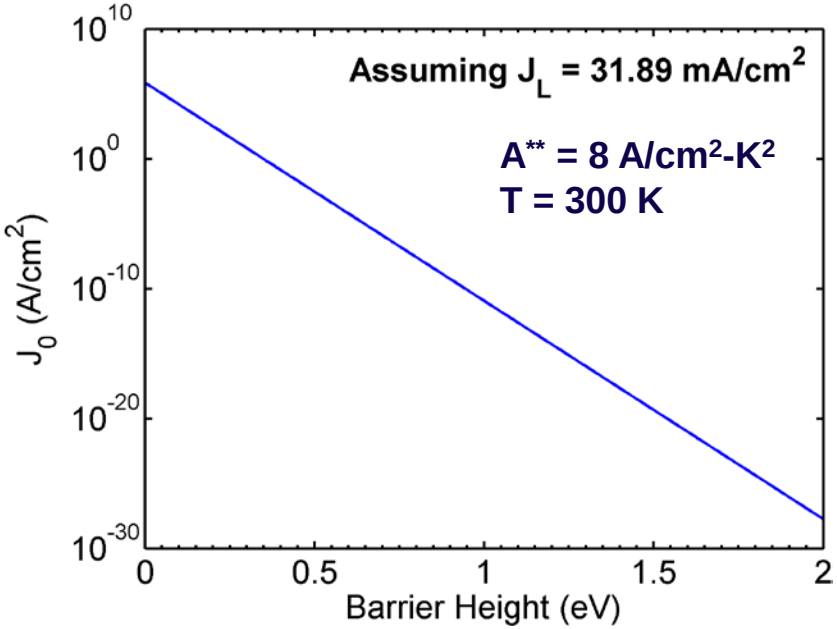


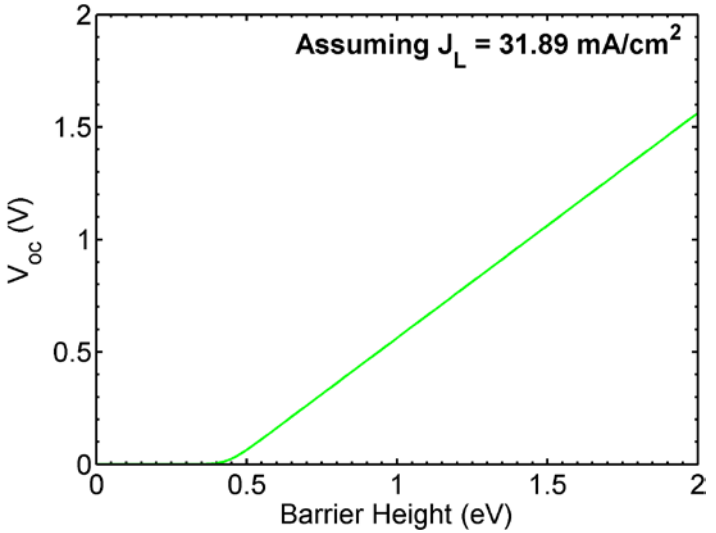
Ideal MIS

Analytical Underpinning

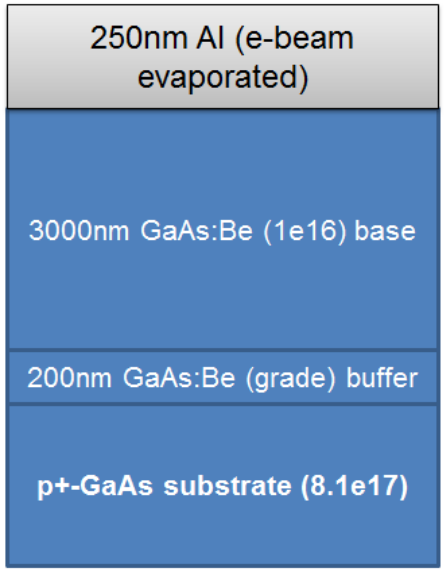
$$V_{oc} = \frac{nkT}{q} ln(\frac{J_L}{J_0} + 1)$$



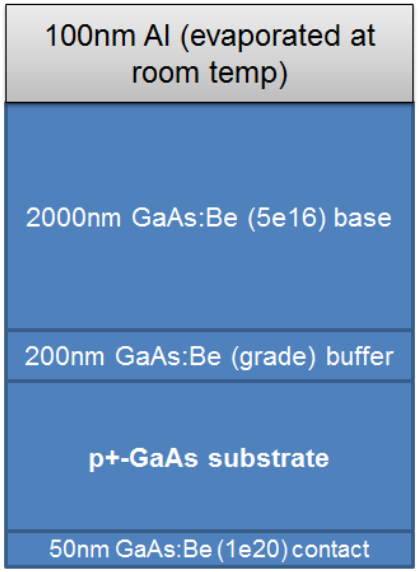




Experimental Approach

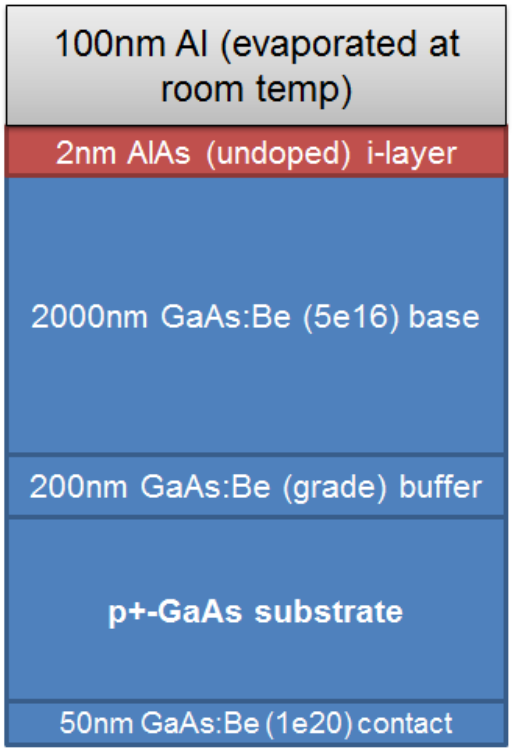


A9-5: Al (E-Beam)



A21-2: Al (MBE)

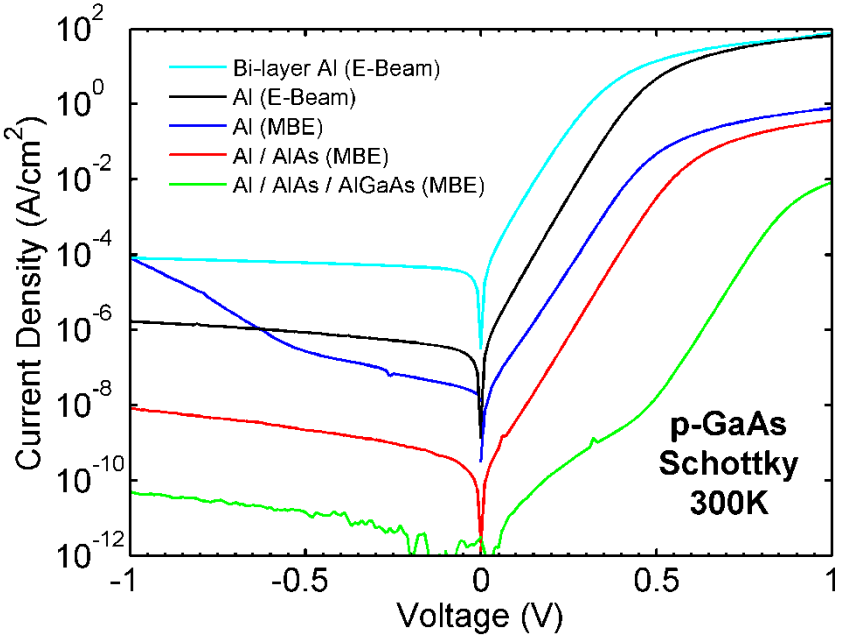
Baseline

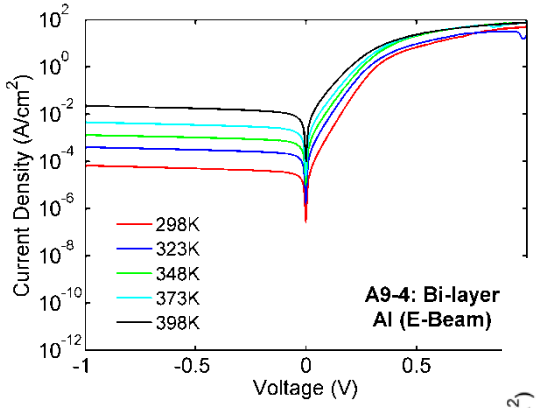


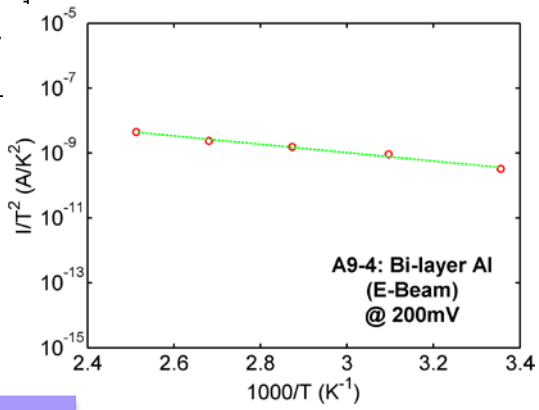
A20-4: Al / AlAs (MBE)

A23-1: Al / AlAs / AlGaAs (MBE)

Results - Experimental







Sample ID	*n*	J_0 (A/cm²)	$\Phi_{B\text{-}JVT}$ (meV)
A9-5: Al (E-beam)	1.08	1.03e-6	709
A21-2: Al (MBE)	1.19	2.76e-8	736
A20-4: Al / AlAs (MBE)	1.11	1.97e-10	
A23-1: Al / AlAs / AlGaAs (MBE)	1.14	4.95e-16	933

SBH
+200 meV

Conclusions / Future Work

- Fermi Level Pinning still an inhibitor
- Interested in application to thin-film III-V PV
- Currently working on AZO / ZnO / InP solar cells (7.3% efficient, to be published)

What if a semiconductor alloy existed with…

- Band gap range of 1.42 – 2.67eV
- No miscibility gap
- Lattice-matched to GaAs
- Previously demonstrated in bulk form

Introducing…ZnSe-GaAs!