

Dilute Nitride (GaInNAs) Solar cells

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Solar cell efficiency

Single Junction

- Efficiency 25-30%
- Single material
- Limited performance

		IIIA		IVA	VA	VIA	VIIA	VIIIA
		5	6	7	8	9	10	2
		B	C	N	O	F	Ne	He
		10.811	12.011	14.007	15.999	18.998	20.183	4.003
IB	IIB	13	14	15	16	17	18	
		Al	Si	P	S	Cl	Ar	
		26.982	28.086	30.974	32.064	35.453	39.948	
29	30	31	32	33	34	35	36	
Cu	Zn	Ga	Ge	As	Se	Br	Kr	
63.54	65.37	69.72	72.59	74.922	78.96	79.909	83.80	
47	48	49	50	51	52	53	54	
Ag	Cd	In	Sn	Sb	Te	I	Xe	
107.870	112.40	114.82	118.69	121.75	127.60	126.904	131.30	
79	80	81	82	83	84	85	86	
Au	Hg	Tl	Pb	Bi	Po	At	Rn	
196.967	200.59	204.37	207.19	208.980	(210)	(210)	(222)	

Multi Junction

- Efficiency 45%
- Multiples materials
- Wider range of energy collected
- Requirements:
 - Must have high quality material
 - Matching lattice material

Dilute nitride solar cell and passivation

Nitrogen

- Lattice matching
- Lowers band gap
- Control band gap with Indium
- Want band gap of 1 eV
- Reduced performance

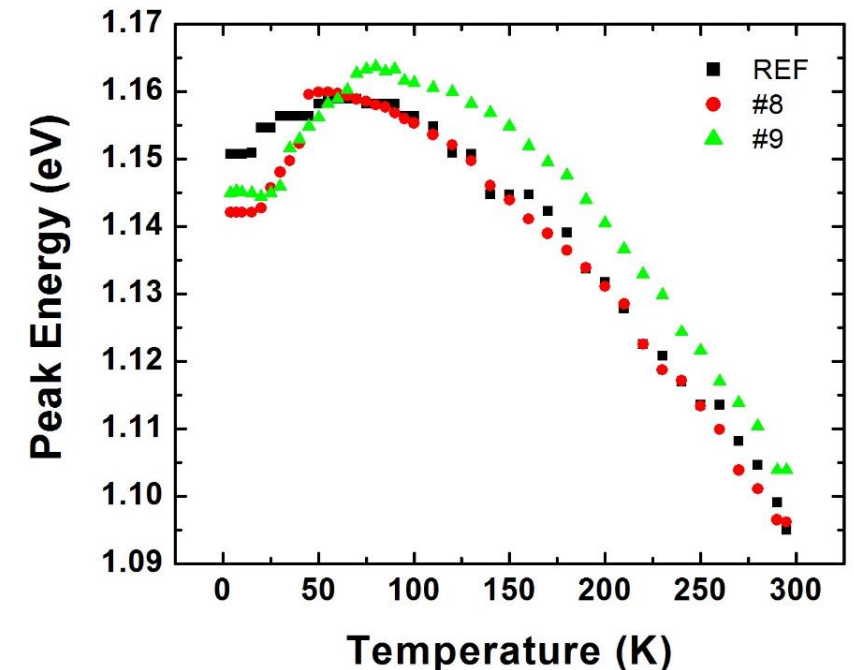
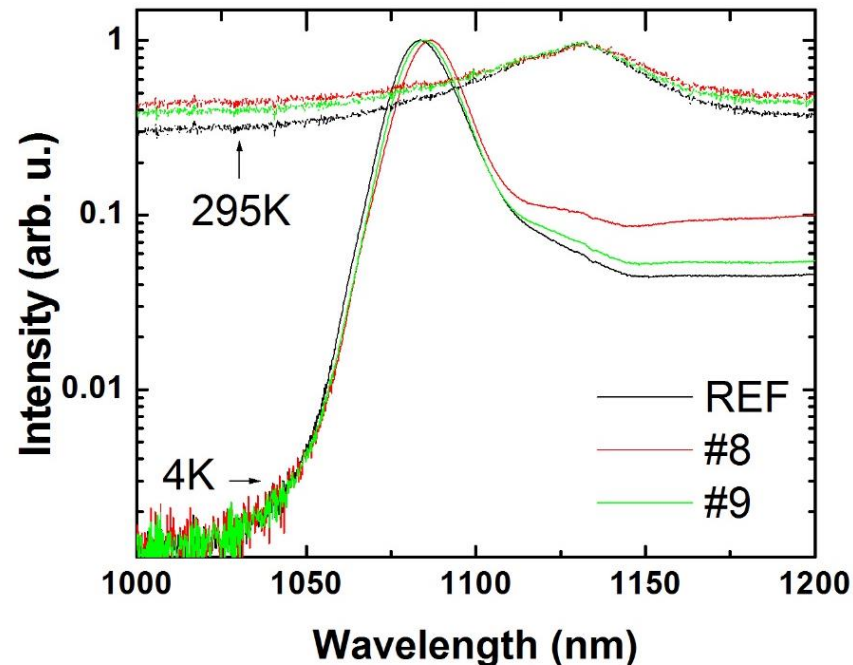
Passivation

- Rapid thermal annealing
 - Effects atom configuration
- Hydrogenation
 - Neutralization of defects
- Removes effects of impurities

Photoluminescence PL

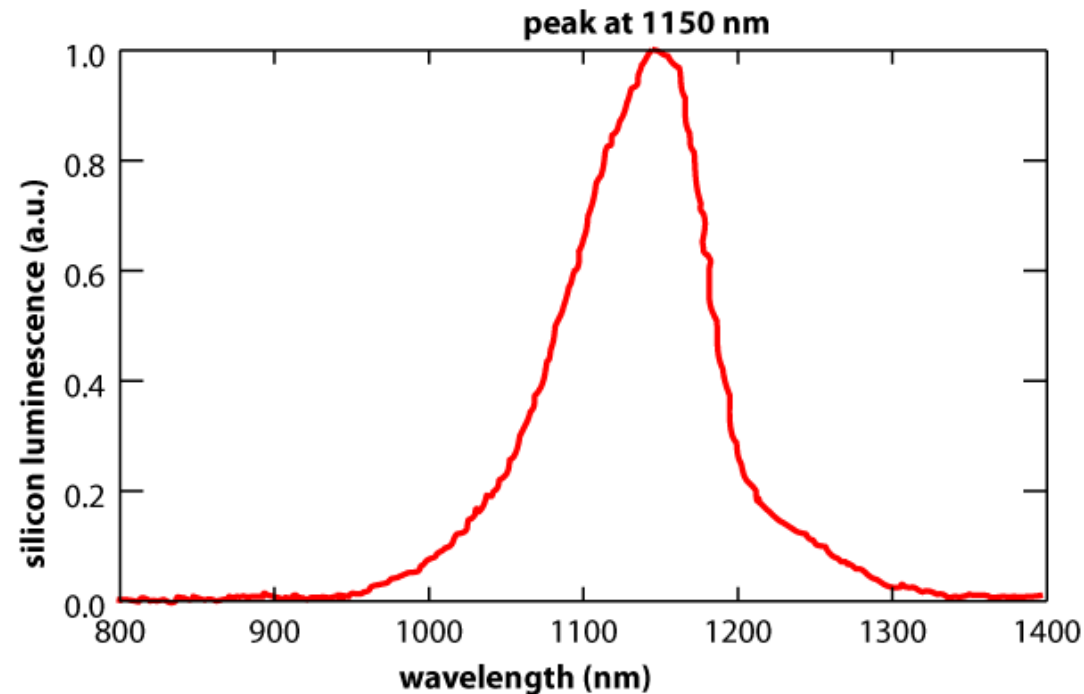
- Input light
- Produces light
- Measure intensity throughout the cell

Temperature
dependent
photoluminescence



Electroluminescence EL

- Input current
- Produces light
- Measure intensity across active region



Quantum Efficiency QE

- EQE \uparrow , external losses \downarrow , carrier extraction efficiency \uparrow
- Tells us about absorption within the cell
 - What light is and is not being absorbed
- Ideally: $EL + QE = 100$

