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LECTURE 5

INTRINSIC SEMICONDUCTOR

NO IMPURITIES

ONLY THERMAL EXCITATION

1 ELECTRON TRANSITION = 1 EHP

AT EQUILIBRIUM

$$n_0 = p_0 = \underbrace{n_i}_{\text{INTRINSIC CONCENTRATION}}$$

n_i DEPENDS ON

1) MATERIAL $\rightarrow$ E_g $\Rightarrow$ $E_g\uparrow$ $n_i\downarrow$

2) TEMPERATURE $\rightarrow$ $T\uparrow$ $n_i\uparrow$

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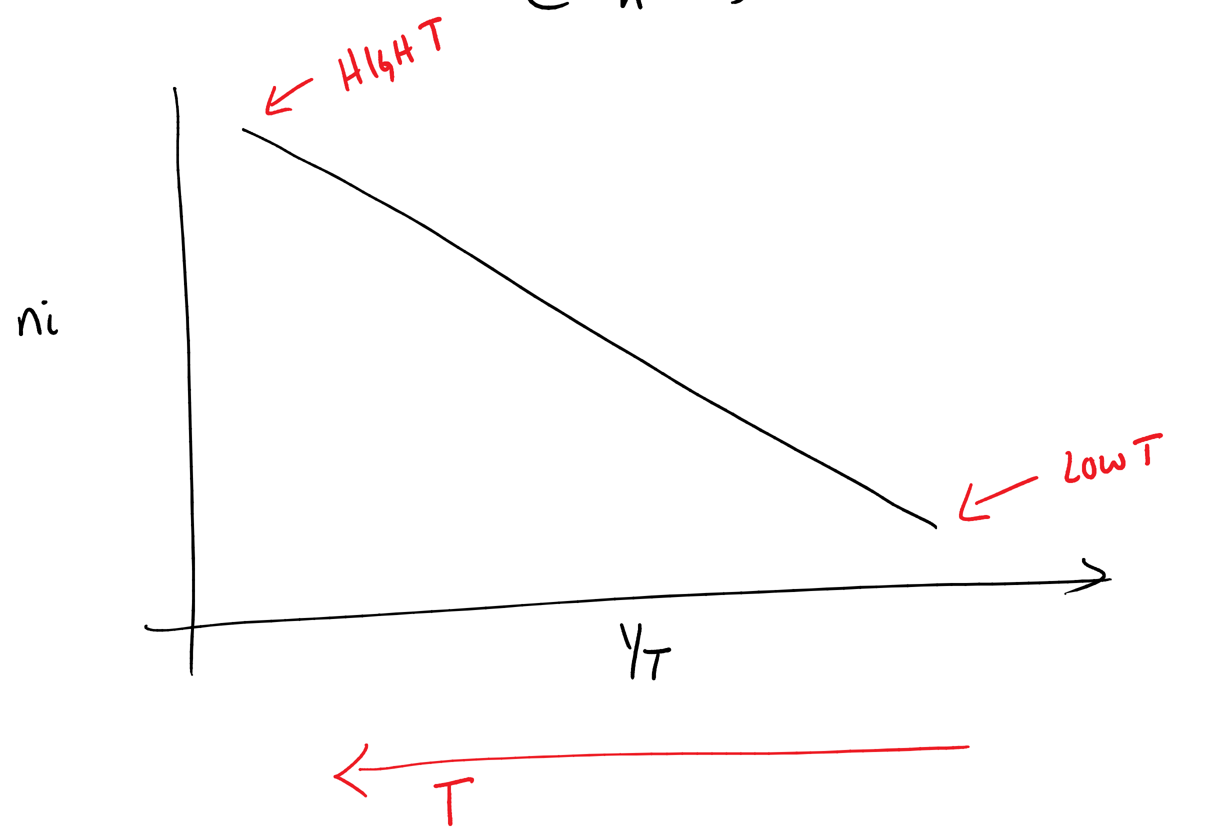
FOR A PARTICULAR MATERIAL

$$n_i(T) = 2\left(\frac{2\pi K T}{h^2}\right)^{3/2}\left(m_n^* m_p^*\right)^{3/4} e^{-E_G/KT}$$



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AT 300 K

	EG	ni
Si	1.12 ev	1.5×10^{10} cm^{-3}
Ge	0.67 ev	2.3×10^{13} cm^{-3}
GaAs	1.42 ev	2.1×10^{6} cm^{-3}

EG ↑ ni ↓

COMPOUND III - V	EG (ev)
GaN	3.4
GaP	2.26
GaAs	1.42

↓ EG ↓

∵ ELECTRONS IN HIGHER STATES

∴ Eg IS LESS

Si

$n_i (T = 300K) = 1.5 \times 10^{10}$ cm^{-3}

$n_i (T = 250K) = 1 \times 10^{8}$ cm^{-3}

T ↑ ni ↑

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RT → ROOM TEMPERATURE

$T = 300\,K$

$$KT = (8.62 \times 10^{-5}\ eV/K)(300K) = \underline{\underline{0.0259 eV}}$$