Alloys

concentration 1% + → not dopants any more

"average" atom

bandgap engineering handout

→ discussion of quantum wells

Type 1 vs Type 2

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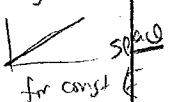
day 38 pg 1

End of Ch 3

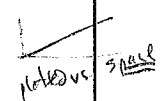
→ skipping misc topics at end

- Thermoelectric
- Superlattices
  - Bloch oscillator
  - Zener tunneling ← actually, maybe explain

Applied $\vec{E}$ → tilty bands

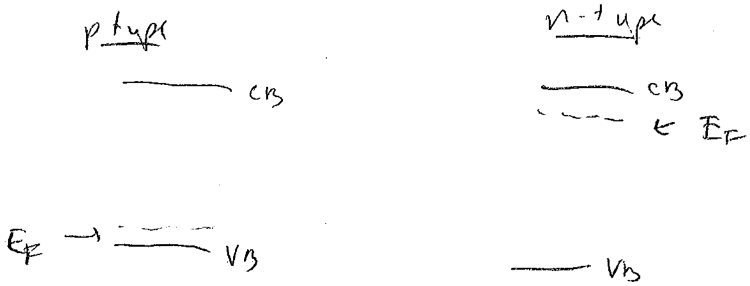
because $V =$  for const $\vec{E}$

then $U \sim V$

U = existing U ± 

~~[Rest of semester probably fewer qns, more concepts]~~

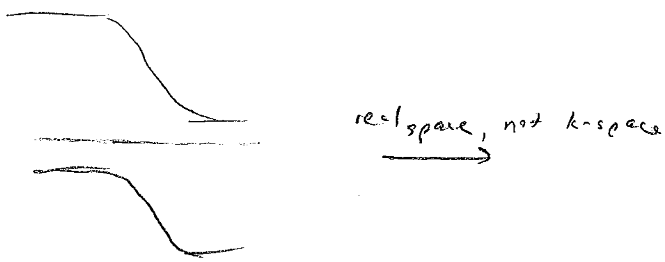
Ch 17: p-n junctions



What if you put them together?

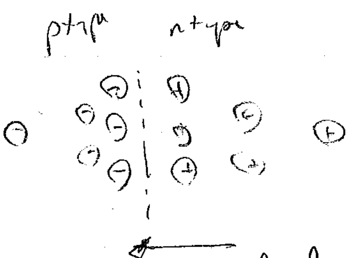
What happens to E_F?
- like p-type?
- like n-type?
- in middle?
- other? ← *

Answer

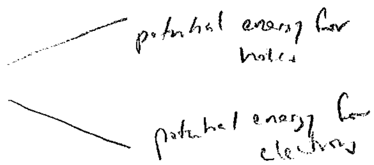


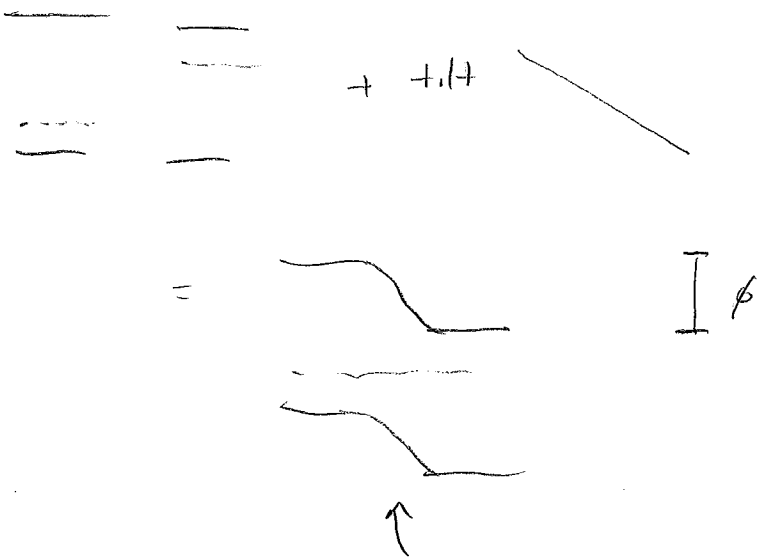
how does that work?

→ charge diffusion across barrier
- p-type picks up some extra electrons
- n-type " " " extra holes



tilts the band like so:





"depletion region", about 1 μm long

lack of charges → holes get pushed left
electrons get pushed right.

If any remain, then
electron-hole recombination

Also called "space charge" region,

because there will still be some
negative extra electrons on left + positive holes on right
(otherwise would have electric field any more)

from acceptors who have given up holes

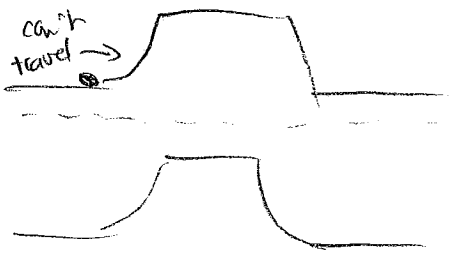
from donors who have given up electrons

Stokes: $\phi = \frac{kT}{e} \ln \frac{N_d N_a}{n_i^2}$

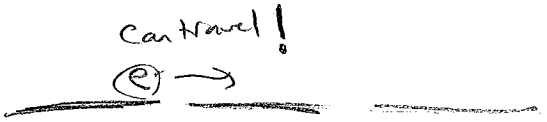
↳ intrinsic concentration, as found a few lectures ago

(Maybe make do for ~~Test~~ Final Exam)
set E_F left = E_F right

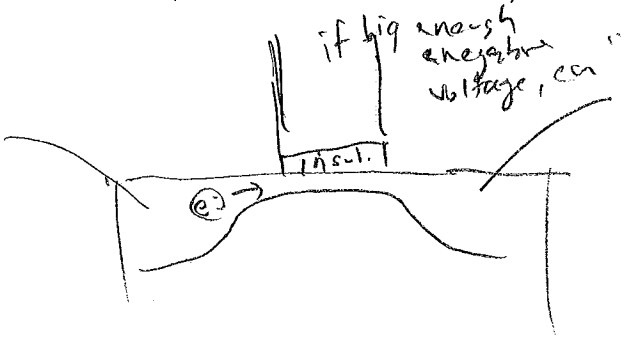
npn transistors ("early" transistors)



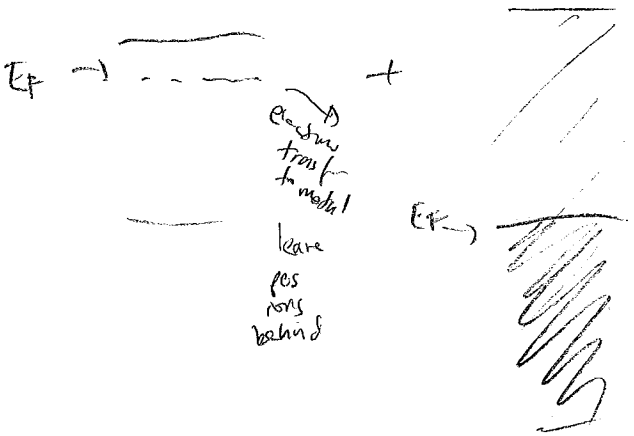
apply Voltage (field) to middle gate



FET (most modern transistors)



Schottky Barrier — S.C. + metal



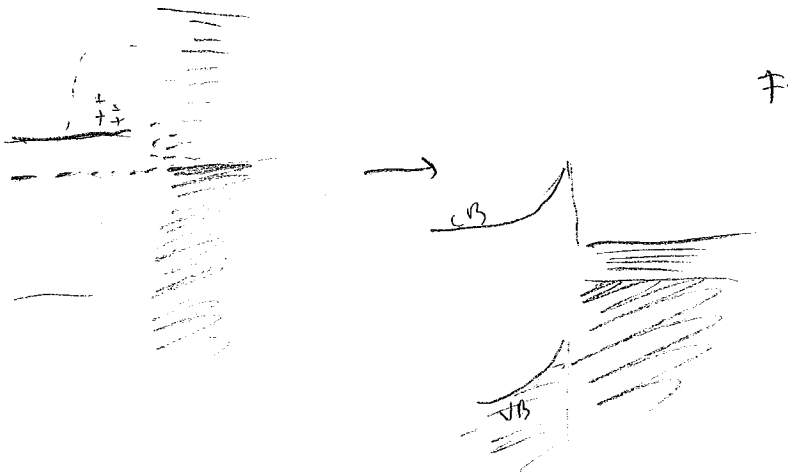
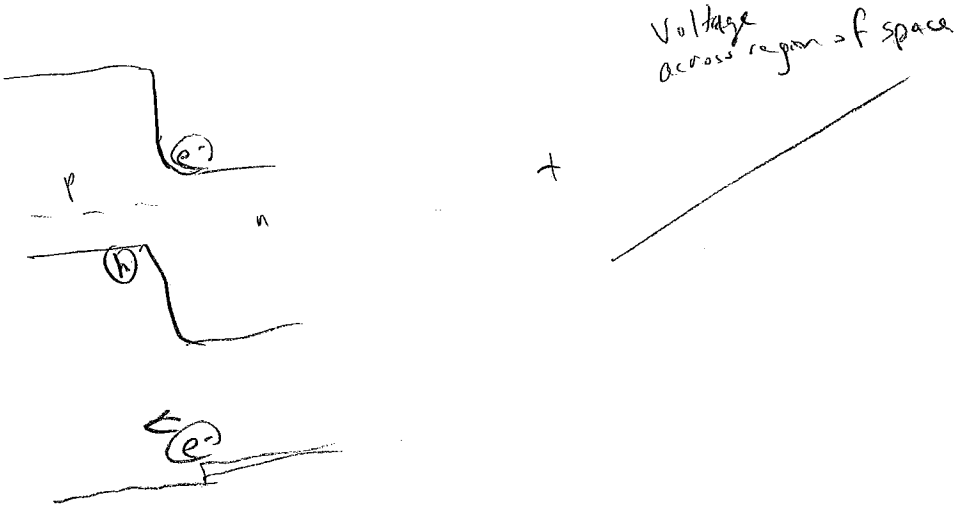


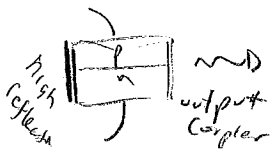
Fig 17.14

LED ← diode = pn junction



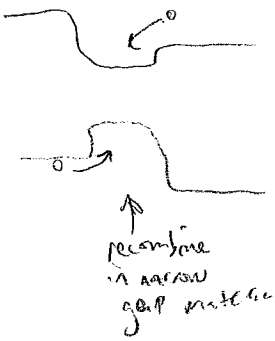
what at same spot / can "recombine" + emit light

Lasers in principle just LED with mirrored sides



electricity to keep upper state occupied

More common: thick QW



recombine in narrow gap material

Need direct gaps!