eo3gadt

Physics of semiconductor devices

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B601

Books

semiconductor physics and devices by D.A. Neaman

physics of semiconductor devices by S.M.Sze and K.K.Ng

inverter can be used to create all logical operations / gates

increase voltage → amplifier eg : op Amp
decrease voltage → rectifier

let the threshold current for 'on' state be 10mA.
even then, 9mA will be considered 'on' because there isn't sufficient difference and hence difficult to sense by hardware

$V = IR$ → consequence of the Ohm's Law (input: V, output: IR, constant: R)

Ohm's Law → $\bar{J} = \sigma \bar{E}$ (current density, conductivity, electric field)
which leads to $V = IR$

Resistance is different for different metals because of mobility

Current density: no. of electrons flowing per unit area per length

$$\sigma \propto \frac{1}{R}$$

$\sigma = n q \mu$ (n: no. of electrons, q: charge, μ: mobility)

generally, a system with high $\sigma \equiv$ metal

Systems with lower $\sigma \equiv$ semiconductors

electrons are bound with the atom due to electrostatic forces

$$\bar{E} = \frac{-dV}{dx}$$ (electric field goes from higher potential to lower potential)

intel i7 processor has 7 bil transistors

processor has → contact pins
global interconnect } vias (metal)
local interconnect
transistors

The vias enable us to access all billions of transistors using limited ~100 contact pins

imp question : which material to be used

TRANSISTOR

Gate	metal
1.2nm SiO_2	insulator
silicon substrate	semiconductor

10Å = 1nm

diameter of an atom: ~1-2 Å
dimension of a transistor: ~20nm

metal gate
insulator
inversion channel
depletion layer

copper and Al suitable for via
→ not only cheap

when electrons move between materials, they collide
these collision are inelastic
↓ no conservation of energy / momentum
↙ most probable
energy here is heat energy
This is the reason filament bulbs glow

x: real dimension
K: momentum dimension

Passing marks: 25%.

2 × Assignment	15%
4 × quiz	20%
Mid sem	30%
End sem	30%
	95% + 5% attendance

Relative Grading

no N-1 policy

Assignment	①	②
deadline	15/02	18/04

calculator allowed for quizzes

Attendance

>60% before & after mid sem	5%
>60% before only	2.5%
after only	2.5%
<60% born	0%