



COLLEGE OF ENGINEERING & TECHNOLOGY

Department: Electronics and Communications

Lecturer : Prof. Dr. Mohamed El-Banna

TA: Amr El-Helw

Course : Electronic Circuits II

Course Code: EC 432

Sheet 1

1. Find approximately how many 25-mm² integrated-circuit chips can be obtained from a slice of silicon crystal 12 cm in diameter.
2. Using the data given in the attached graphs, determine by calculation whether successful n-pocket isolation is obtained by an error-function Boron diffusion through a 3- μm -thick n-type silicon epitaxial layer containing 5×10^{15} donor impurity atoms/cm³ grown onto a p-type silicon substrate, if the diffusion takes place.
 - a- at 1200°C for 1h.
 - b- at 1100°C for 1.5h

(Hint: For successful isolation diffusion the density of Boron impurities which penetrate the 3- μm -thick epitaxial layer must be greater than the density of n-type impurities everywhere in the penetrated region of that layer, where conversion to p-type is necessary.)

3. Determine the depth below the surface of a p-n junction produced by the Gaussian diffusion of Boron into the n-type epitaxial layer of problem (2). The drive-in diffusion is carried out at 1100°C for 30 minutes after a Boron surface deposition of 1×10^{12} /cm².
4. Determine the depth below the surface of a p-n junction produced by the ion implantation of Boron into the epitaxial layer of problem (2) at an implant energy of (a)- 100 keV and (b)- 200keV

Boron Ion Energy keV	Range R_p μm	Straggle ΔR_p μm
100	0.30	0.07
200	0.50	0.09

The incident Boron flux is 1.5×10^{15} ions/cm².

5. The average resistivity of the diffused p-layer used to fabricate a monolithic integrated resistor is $0.1 \Omega \cdot \text{cm}$ and the depth of this layer is $1.5 \mu\text{m}$. Assuming the width of the diffused resistor is limited to no less than $2.0 \mu\text{m}$ by the ability to etch a narrow line in the oxide (caused by the basic resolution of the photoresist)
 - a- Calculate the length of the resistor line required to produce 10^4 - Ω resistor.
 - b- If the change of this diffused resistor value with temperature is 3000ppm/°C by what percentage will the resistor value change for a temperature rise of 10°C.