EE 5621 QUIZ 2 1 October 2021

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Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **NOTE: Be careful with units!!!**

**Problem 1** (50 Points) Silicon Diffusion

Hypothetically, assume a donor **constant/infinite** diffusion is used to obtain a linear donor doping profile given by n(x) = [(8.0 x 1019) – (1.5 x 1023)x] cm-3 as illustrated in the graph. Note that the doping profile is NOT to scale! The oppositely doped substrate acceptor concentration is given by NA= 1 x 1017cm-3.

n(x)

Doping Profile

8.0 x 1019 cm-3

NA= 1 x 1017cm-3

x

1. (10 Points) Compute a value for the junction depth, xj, in μm.
2. (15 Points) Compute the dose, Qo in atoms-cm-2. Note that strictly speaking, you should be evaluating an integral, however, the assumed linear doping profile allows you to significantly simplify this mathematical effort. Think triangles!
3. (15 Points) This **constant/infinite** diffusion is now capped with an SiO2 layer and we proceed with a **finite (limited) source**  diffusion at a temperature T1 for a time t1. During this time used for this finite source diffusion, the surface concentration will (**INCREASE, DECREASE, REMAIN THE SAME**); the junction depth, xj, will (**INCREASE, DECREASE, REMAIN THE SAME**); and the dose, Qo, will (**INCREASE, DECREASE, REMAIN THE SAME**).
4. (10 Points) List two possible donor dopants:\_\_\_\_\_\_\_\_\_\_\_\_and \_\_\_\_\_\_\_\_\_\_\_\_\_ and two possible acceptor dopants: \_\_\_\_\_\_\_\_\_\_and\_\_\_\_\_\_\_\_\_\_\_\_.

**Problem 2** (50 Points; ) Oxidation

1. (10 Points) The chemistry formula a dry oxidation is:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and for a wet oxidation is:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. (16 Points) Compare the time to grow a 0.1 µm SiO2 layer using a **wet oxidation** and a **dry oxidation**.
3. (6 Points) The diffusivity of Na into SiO2 is

(**MUCH LOWER, LOWER, ABOUT THE SAME, HIGHER, MUCH HIGHER**) than the diffusivity of virtually any material into SiO2. This diffusivity is (**A PROBLEM, NOT A PROBLEM, MAKES NO DIFFERENCE**) in the overall quality of the IC processing. The source of this Na is probably

 (**Photoresist, Low resistivity H2O, High resistivity H2O, Dopant gases**).

1. (6 Points) An FET gate oxide is best accomplished using a (**WET, DRY**) oxidation process because a gate oxide is (**THICKER, ABOUT THE SAME, THINNER**) than a field or masking oxide and the defect trap state density is (**HIGHER, ABOUT THE SAME, LOWER**) than a field or masking oxide. Circle your choices.
2. (12 Points) The 2 µm silicon layer shown below is subject to a 3 hour wet oxidation at 1050º from the **top** only. **Sketch and label** the resultant cross-section layers and approximate dimensions for both the remaining Si and SiO2.

2 µm