Homework 3

ECE 4339

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1. (100 pts) The problem of an unknown wafer *(problem solving skill and integrated knowledge)*

You just bought an intrinsic GaAs wafer from a resale warehouse who claimed that the impurity level is definitely below a few times 10^{15} cm^{-3}, but they did not do any characterization and could not tell what types of impurities in there, n-type or p-type; nor do they know its mobility and resistivity. Your boss wants to know: majority carrier type (n or p), resistivity, and mobility. But you are about to go on vacation and want to ask your co-workers to do you a big favor.

1.1 Question 1 (20 pts)

Write out the entire instruction plan in details what you want your co-workers do for you. You have to specify what experiments to do, how to do it, what to measure, what to look for, etc. (Hint: remember that you are asking for a favor, the burden of clarity is on you to explain to your co-worker)

1.2 Question 2 (25 pts)

Your nice co-worker called you while you are on the beach and the conversation went like this:

YOUR CO-WORKER: "I looked on the bench and there were two wafers, which one you want?"

YOU: "Well, only one is what we want to measure, I don't know what the other one is"

YOUR CO-WORKER: "Oh I remember, I think the other is Sam's. He was working on his InP wafer, but he's gone on business trip"

YOU: "Mine should be about 2-inch in diameter"

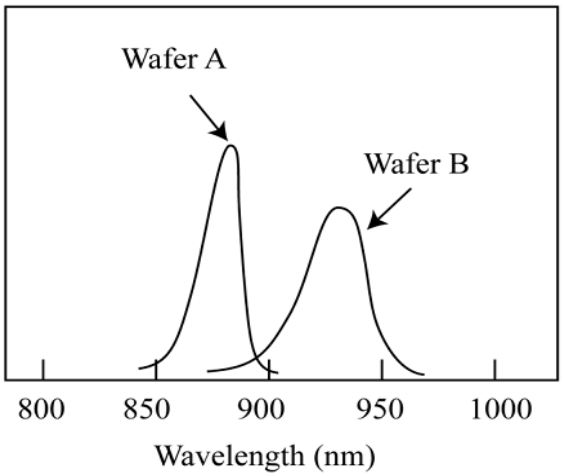
YOUR CO-WORKER: "Let's see... They both are 2-inch, both look black, in the same kind of fluorware container, let me measure their thickness… Well, both are 10 mil (1 mil is 1/1000 of an inch)

What will you tell your co-worker to do next?

1.3 Question 3 (25 pts)

When you got back to the hotel, you were told that you had an urgent fax from your company, as shown below. What is shown in this fax? What is your response? And explain.

Tell us ASAP: Do you want wafer A or B?



1.4 Question 4 (30 pts)

Your co-worker called again and told you that the resistivity he got was ~ 2.6 Ω-cm, and he had a postive Hall effect. Here is how the conversation went:

YOUR CO-WORKER: "I got a Hall voltage reading of 42 mV "

YOU: "How high did you crank up the magnet?"

YOUR CO-WORKER: "It says 5 kG here"

YOU: "How much current did you use on the sample?"

YOUR CO-WORKER: "1 mA "

YOU: "And you said the voltage was positive?"

YOUR CO-WORKER: "Well, that's what the tags say, this tag says plus and this one says minus"

YOU: "Those scotch-taped tags fell off all the time. You're sure they were put on right?"

YOUR CO-WORKER: "I dunno, but they didn't fall off the whole time I was doing! Oh! One more thing, a guy from Wafer Warehouse called. He said you left a message for him asking about this wafer you bought? here is his extension… "

YOU: "Great! Thanks a bunch! That's what I have been waiting! I'll call him right now".

You called the Wafer Warehouse and here is how it went:

YOU: "Hey, I want to know what impurity, concentration, mobility etc. for that wafer I bought on sale from you?"

WAFER WAREHOUSE: "Sorry, we didn't really know those things. We forgot to do it before shipping out to you. One thing though, for that batch, I think most of the impurity is tellurium "

YOU: "You are sure?"

WAFER WAREHOUSE: "Our analysis of other samples, all indicate tellurium, may be with very little carbon, that's all we know about it! "

What are you going to report to your boss? must explain your reasoning and show your work to get credit.