EE M150L Lab Report 1 J. W. Judy

Due: Dec 9th (Friday)

Content of Lab Report 1:

The first lab report will be a no nonsense discussion of the relative successes and failures of the microfabrication process performed by your team in an effort to follow the as-designed traveler.

Imagine you are at a company and you are responsible for creating the fabrication process for a product. This process will be used by technicians to mass produce the parts. Imagine your team designed the fabrication process that you have been following in your traveler. The purpose of the this first report is to document how well the fabrication process went and how successful it was in producing the parts as designed in the layout and in the process. It is in the second report that you will focus on the performance of the devices. Since in that second report you will relate device performance (good or bad) to the results of the fabrication process as realized by your team in lab with the wafer, it is important to carefully document the actual fabrication process performed. Thus, this first lab report is a concise yet complete version of the needed documentation. Your team is essentially free to write it with any organizational structure you want, but the report must be designed for professional engineers at your company to read and understand quickly. That is why it must be complete and accurate yet concise. Although your team has freedom when putting the report together, it must contain the following items:

 Introductory Material:
- Cover page with title, name and ID number for each team member, date, and total word count (the team with the highest point-to-word ratio will be recognized and rewarded)
- A general overview of the process as designed
- A discussion of each physical layer used in the fabrication process and its purpose
- A discussion of major process technology used and its purpose (e.g., LPCVD, RIE, plating, etc.)
- A cost analysis of the fabrication process (see below for more details)

Top Views and Cross Sections During the Process Flow:
- Draw all important top views and cross sections and provide a brief narrative for (1) a cantilever-based magnetic microactuator with polysilicon sacrificial layer and (2) a pressure sensor.
  - minimize the use of PR in your drawings (impossible to do for the plating steps)
  - you may draw each cross section by hand if you want, otherwise PowerPoint or some other drawing package could be used
  - try to include as many details as you can (e.g., undercutting, sidewall profiles)
  - make sure to carefully annotate each drawing so that all layers and key features are clearly identified
Results of Fabrication and Analysis
- Discuss briefly the purpose of each measurement and the technology involved
- Determine all the important device geometries needed to predict their performance and record this information in the table provided on the webpage or as an email attachment. Compare your measurements with the as-designed value and explain any large discrepancies.
- Put the misalignment measurements for each photolithography step in the table mentioned above
  o discuss which alignments are more crucial than others
  o explain any large misalignment errors and briefly predict any possible negative impact

Testing and Analysis – Resistors:
- Succinctly discuss the test structure and how it is meant to operate
- Succinctly discuss the specific experimental setup and testing procedures used
- Succinctly discuss the theory involved and provide the key equations governing performance
- Succinctly convey the experimental results obtained (i.e., you may use graphs with error bars, tables, or any other similar method)
  o provide raw data, calculate sheet resistance, calculate contact resistance (use table above)
  o graph resistance versus number of boxes
  o fit a line to this data and find slope (sheet resistance) and y-intercept (contact resistance)
- Compare measured results with theory and identify any significant lower-than-expected and higher-than-expected performance as well as any failures
  o discuss why the calculated sheet resistance is different from theory and possibly any sheet-resistance measurements you performed on the full film of polysilicon
- Succinctly relate process-related deviations or variations, which were documented elsewhere in this report, to any significant differences from theory
  o discuss any trends seen and any discrepancies in the data
  o correlate these trends/discrepancies to processing flaws if possible
  o how could these flaws, if any, be addressed when the process is repeated next year

Conclusions:
- Summarize the objectives of the process as currently designed
- Summarize the reasons for the failures in the process (please be a bit more verbose here)
- Briefly anticipate the potential impact of the process as actually performed by your team on the devices and test structures (this will be analyzed more carefully in the second report)
- Propose changes to the process design that will increase the chance for success in future runs

Appendices:
- Attach the travelers used in the lab with the measurement results as captured during the process

General Information and Rules:
- Each group will turn in one laboratory report
- Everyone in the group will receive the same grade
- Formatting Requirements:
  o Font: 12-point Times New Roman
  o Margins: 1-inch margins
  o Line Spacing: 1.5 lines
  o Tables: a font as small as 8 point or 10 point can be used.
- The number of pages of the lab report should be reasonable. It is **not** the longer the better! Keep it concise and stick with the most important information.
- Please express thicknesses in \( \mu m \), pressure in mtorr, etching and deposition rates in \( \mu m/min \), power in W, and time in minutes or seconds.
- Assume that the reader is a fellow engineer and already knows what LPCVD, DRIE, RIE, etc, are (there is no need to explain them in great detail).

**No Cheating (duh!):**

- You are not allowed to work on the lab report with other groups!
- The only people you can work with are the people in your group!
- Do not copy any part of any current or previous reports for this class.
- Do not copy the cross sections prepared by other groups. If you copy from other people, your group and the group where the information came from will receive a zero for that section.
- We only mention this issue because it has happened before on more than one occasion.