

Foundations of Semiconductor Manufacturing

LAB ACTIVITY: MICROSCOPIC ANALYSIS OF YIELD-KILLING CONTAMINANTS

Name	Class/Period	Date

1. Overview

In this lab activity, you will examine every day environmental contaminants under high magnification. In a semiconductor cleanroom, microscopic particles are not just dirty; they are "killer defects" that can short-circuit or destroy nanoscale electrical pathways. You will prepare your own sample slides containing hair, clothing fibers, dust, and salt, and observe their massive scale compared to the integrated circuits you examined previously.

2. Performance Objectives

After completing this lab activity, you will be able to:

- Successfully prepare simple dry-mount observation slides using standard classroom materials.
- Operate a digital microscope to focus on and illuminate varying types of particulate matter.
- Identify the physical characteristics of biological, environmental, and chemical contaminants (hair, fibers, salt).
- Explain how specific contaminants physically or chemically damage semiconductor wafers (e.g., sodium corrosion, particulate blockages).

3. Required Materials

The following materials are required to complete this lab activity:

- High-magnification digital microscope (1 per team)
- Blank white index cards (2 per team)
- Clear double-sided tape or folded single-sided tape (1 roll per team)
- Fine-tipped tweezers (1 per team)
- Contaminant sources: a human hair, a pinch of table salt (sodium chloride), and fabric fibers (from a sweater or lint trap)
- A small classroom dust bunny or floor sweepings

4. Preparation Checklist

Before beginning the lab activity, review this checklist and mark off each item as you complete it.

- All hardware components and slide preparation materials are distributed.
- The digital microscope is powered on, and the lighting is adjusted for opaque object viewing.
- You have read through the entirety of this document to familiarize yourself with the requirements.

5. Lab Activity

5.1. Key Terms

Before beginning the inspection, review these key terms:

- **Killer Defect:** A particle large enough to break a circuit pattern. They cause a microchip to fail completely.
- **Particulate:** A microscopic piece of solid matter suspended in the air (like dust or dead skin).
- **Sodium Contamination:** Chemical damage caused by salts (often from human sweat or breath) that aggressively corrode aluminum wiring on a chip.

5.2. Sample Preparation (Dry Mounting)

You will now prepare a simple mounting surface to hold your contaminants still under the microscope.

Perform the following:

1. Take a blank white index card and apply a strip of clear double-sided tape across the middle.
2. Using your tweezers, carefully pluck a single hair from your head or arm and place it flat onto the left side of the tape.
3. Take a tiny pinch of table salt and sprinkle 3 to 4 individual grains onto the middle of the tape.
4. Use your tweezers to extract a tiny thread of fabric from your clothing or a provided dust bunny and place it on the right side of the tape.
5. Gently press down on the edges of the items with the back of your tweezers to ensure they are stuck to the tape and will not blow away.

5.3. Microscopic Observation: Feature Density and Structure

Perform the following:

1. Place the index card under the digital microscope.
2. Observe the hair: Focus on the hair at maximum magnification. Note the rough, scaly texture of the biological surface. Discuss with your team what would happen if a structure of this immense size landed across the microscopic metal interconnects you observed in the previous wafer lab.

- 3. Observe the salt: Move the card to focus on the salt grains. Note the sharp, crystalline structure. Salt contains sodium, which is highly mobile and will eat right through a silicon die's protective layers.
- 4. Observe the fibers/dust: Move to the fabric fiber. Notice how a single thread is actually made up of dozens of smaller, frayed micro-fibers, each capable of shedding hundreds of killer defects into the air.

6. Authentic Skill Assessment

Have your instructor verify that you have met the requirements for the performance objectives and sign below. Keep this lab activity sheet for future reference.

Instructor Signature	Date