ECEn 555 – Optoelectronics Devices Lab

Week 10

"Wafer Thinning and Cleaving"

In this lab you will learn the processes used in the production of edge emitting lasers. Critical to their construction is the cleaving of high quality facets that will serve as mirrors for the lasers. To produce a very clean cleave requires that the wafer be thin – much thinner than the substrates epitaxial material is typically grown on. In this lab, you will go through a "mock-up" of the thinning and cleaving process used for real edge emitting wafers. You will use InP substrates but without laser epitaxial lasers grown on them. In next week's lab, you will use real laser material and begin the process of laser fabrication

Major Objectives

1. Wafer Thinning – Mounting chip. In this objective you will use the well know technique of lapping and polishing to thin down a piece of InP to about 150 microns in thickness. To do this, you will use a specially designed lapping fixture machined from Stainless Steel. The lab supervisor will show you this fixture and explain how it works. Use crystal wax to attach the InP to the removable top of the fixture. The crystal wax melts at 120C, so you need to put the top on a hot plate. Melt the wax and then drop the InP piece into place. Move it around in the wax until you are confident it is flat – much like how you mounted your small LED pieces using photoresist on a piece of silicon. Remove the stainless steel piece from the hot plate and let it dry which will harden the wax – be careful, the metal piece is hot.

2. Wafer Thinning – Lapping. Use a micrometer in the lab to determine the thickness of the InP piece. Measure between the stainless steel top piece and the middle of the InP. Your objective is to thin until the InP is 150 microns or 6/1000 of an inch thick. Attach the top of the etching fixture to its base. Place lapping paper down on a piece of glass with water underneath to keep it from moving. Apply a generous amount of water to the top of the lapping paper. Move the lapping fixture over the lapping paper in a figure-8 motion. You should see streaks of InP material that has been "shaved" off the sample and is now imbedded into the lapping paper. After a few Figure 8's, remove the top from the lapping fixture and measure the thickness of your sample – this should give you an idea of how fast the InP will be thinned. Continue this procedure until the chip is down to 150 microns. Be very careful! InP is quite soft and can be thinned very quickly. If you go much below 150 microns, the chip will be extremely fragile and very hard to handle.

3. Wafer Thinning – Removal. Once the InP chip is at the target thickness you now have to remove it from the lapping fixture. Again heat up the top part of the fixture until the wax melts. Using filter paper, gently push the thin piece to the edge of the fixture and catch it in another piece of filter paper. While the piece is on the filter paper, clean it off first with acetone and then isopropanol. Wait for the chip to dry at this point. If you attempt to blow it dry, this will likely be the last you will see of it.

4. **Cleaving**. A piece of Nitto tape will serve as your mounting platform for this step. Press the sticky side of your tape to your sample and make sure it adheres reasonably well. Put the tape and sample in the cleaving fixture. Use the cleaving fixture to scribe into the side of your wafer in intervals of about 500 microns or half millimeter. Remove the tape and the chip from the cleaving fixture and rub the back side of the tape against a round object to cleave up the chip along the scribe marks. Pull the tape as you do this to try and separate the now small pieces of your chip. Each of these very narrow pieces will serve as a separate set of lasers when you do this with the real material.

5. **Removing Cleaved Pieces.** Using tweezers, now separate the small pieces from the tape and place on a dry towel or wafer carrier. Acetone might help in the separation from the tape. Because these pieces are so small, this can be very difficult. Patience and steady hands are required. Using the microscope and a ruler for calibration, estimate the distance between the cleaved sides on your InP pieces. Hopefully there are a few that match your 500 micron target.