E241 Survey Paper

Pingyu Wang, Timothy Goh

The purpose of this document is to provide "tips" or "tricks" from a perspective of someone who has minimum to zero micro/nanofabrication experience prior to taking the class E241, with the hope that new SNF lab members will find some information useful for conducting the experiments efficiently.

1. Using the Finetech Lambda Flipchip Bonder

The Flipchip bonder offers versatility for various bonding purposes. The tool provides precise alignment for features with sizes as small as several microns, and offers separate temperature control for each of the two workpieces to be bonded. Below are several tips for maximizing the tool's flexible capabilities.

(1) Conduct thorough research on the solder to be used on the Flipchip bonder. Some solders (e.g. indium) are very sensitive to the ambient conditions such as oxygen pressure or humidity [1], it is crucial that bonding experiments involving such materials are conducted in a controlled environment. The Flipchip bonder can indeed be converted to allow operation in controlled environment.

(2) Flux can be applied to assist solder flowing. If the solder oxidizes readily and the oxidation layer prevents the solder from flowing, flux can be applied onto the workpieces immediately before putting the two workpieces together and applying the temperature profile. The arm can be lowered half-way to apply flux to the workpiece mounted on the arm. Since this is done after the alignment, be careful not to push and move the workpieces, and quickly check alignment again immediately after applying the flux, by lifting the arm to its original position and moving the camera back to alignment position.

(3) The microscope for alignment can also be used to observe solder flow while heating up the solder at the base. This is not a bonding test since the arm is not lowered and only the base is heated. This can be done to ensure that the solder will flow during the actual bonding. Procedure for performing this function is as follows:

   a. Mount the workpiece with the solder onto the base;
   b. Move the microscope above the base, and focus on the solder;
   c. Do NOT lower the arm. Apply heating profile ONLY at the base, and the solder flowing behavior can be directly observed with the video shown in the software;
   d. The video can be recorded by clicking the "Video Recording" button in the software;
   e. Once recording and observation is completed, stop the heating profile and wait for the piece to cool down;

f. Remove the piece from the base.

During the process, make sure that there is little smoke generated by the heating, otherwise the smoke will contaminate the lens of the microscope. This process is NOT recommended for any aggressive heating.

2. Lithography Experiments

Usually lithography involves multiple steps, some of which, rather unfortunately, require either very popular tool (e.g. Heidelberg MLA) or very long step (e.g. Innotec metal evaporator). It is essential that the experiments are streamlined according to the availability of such tools.

(1) Conduct quality check after each step. For fabrication processes that involve multiple steps, it is essential that quality control is performed after every major step. For instance, for printing circuit onto wafers, remember to check electrical conductivity frequently.

(2) Conduct quality check before using a very busy tool or performing time-consuming steps. This will make troubleshooting much less costly in terms of time.

(3) Use a dedicated yellow-light-area-only wafer box. Do NOT trust the brain after a long day, or in the early morning, or during parallel experiments. Carrying a box of wafers coated with unexposed or undeveloped photoresist into the white light area does not make pleasant memory.

(4) If tip (3) is not followed and one does end up accidently exposing the photoresist in the white light area, it is found out from our experience that, for 1.6-μm SPR 3612 photoresist, being exposed in the white light area for 20 min will decrease the resist thickness by roughly 0.1—0.2 μm.

(5) Sonication can help with lift-off of thick metalization layers. Aggressive sonication (high power, long duration), however, may damage features already patterned onto the wafers.