Standard Operating Manual

Copper Electro-Plating

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1. Picture and Location

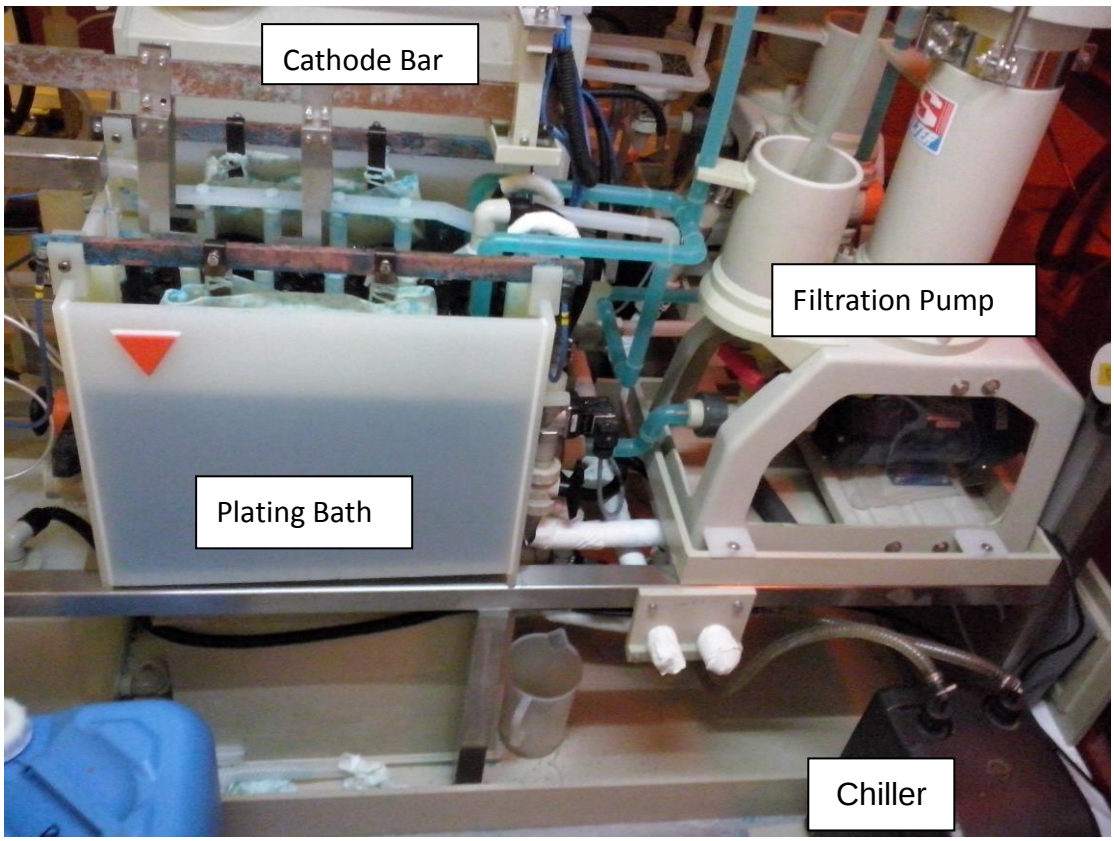

Fig.1: This plating equipment is located at room 2227.

2. Manual wafer Copper plating equipment

The wafer plating equipment features a patented plating cell configuration that is designed to plate Copper on a single wafer of either single or double sides at one time. This plating equipment is fully suitable for plating copper on filling the very small trenches and vias in the two to four inches diameter wafers from 300um to 500um in thickness. Operation of this equipment needs specific training that is served by the responsible Technician.

3. Contact List and How to Become a Qualified User

3.1 Contact person

- NFF Senior Technician: Mr. Henry YEUNG 2358-7896
- NFF Technician: Mr. Michael Kwok 2358-7896

3.2 Training to Become a Qualified User

1. Please follow the procedure below to become a qualified user.
2. Read all materials on the NFF website concerning this machine.
3. Send an e-mail to NFF requesting Copper Plating operation training.
4. Hands-on Operation training for Copper Plating.
5. Pass the examination for the equipment operation and security

4. Copper Plating Process Highlight

4.1 Plating bath chemistry

Copper plating bath use the proprietary process of an acidic solution is formulated for optimum addition of brightener additive to have quality plating result. The successful plating depends on the skill and experience level of the user. He/she can attempt to have plating set-up and estimate the amperage to achieve the actual copper thickness up to 100 micros.

4.2 Wafer cleaning

The user can dip the wafer into the specific cleaning solution indicated in Wet Station F for 2 to 3 seconds period to ensure that all photo resist (PR) residue, oxide are removed to have acceptable plating result specially for wafer surface with pattern of

PR coated.

4.3 Special wafer hanger fixture

The wafer is going to be placed into the plating bath and “hung” from the cathode bar. In order to do this, some special sort of hangers are used to hold the wafer tightly during plating as the Figure 2 & 3.

Fig.2: Wafer Fixture (Single Side Plating)

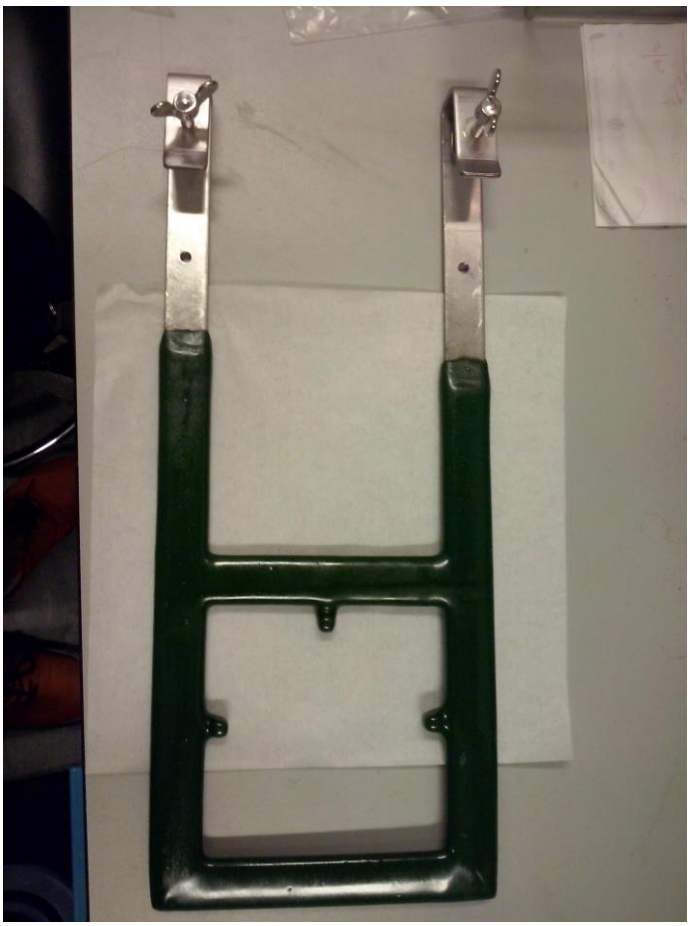

Fig.3: Wafer Fixture (Double Side Plating)

4.4 Panel and Pattern plating

There are two main approaches commonly used when plating the wafer of either single or double side. They are panel plating and pattern plating.

Panel plating

The entire copper surfaces on each side of the wafer, as well as the via, hole are plated up to a desired thickness. The end result is a bright copper that is fully covered in all via and hole of the wafer.

Pattern plating

This involves masking by applying the photo resist on most of the copper surface (40-70%) and plating only the traces and pads of the circuit pattern. Due to the reduced surface area, only 30 to 60% of full current at a much smaller current is generally used.

4.5 Maintenance of Plating Equipment

The Technician always makes sure that the equipment is kept clean and ready for use in a good working conditions. These include clean & replace the filter, perform plating bath analysis on a regular basis etc.

4.6 Plating Parameters Estimation

4.6.1 Copper thickness operation data

Before putting the wafer sample in the plating bath and turning on the power supply, the user needs to figure out the actual current used from below operation experience data. A good plating current range is between 5 and 10 amps per square foot (ASF) of wafer sample surface area. Operation data estimates an acid copper plating bath deposits 14 microns of copper in 1 hour at 10 ASF. This value can only be used as a reference.

4.6.2 Plating current estimation

Assuming 5 ASF as the plating current density, we'll first calculate the area of 2″ x 2″ wafer sample to be plated: { 2″ x 2″ x 1 side = 4 in^2 or 4 (in^2/ 144 (in^2/ft^2) = 0.0278 ft^2 }

So, the actual current that needs to be applied during plating: {(Current density in ASF) x Area (sq. ft.) = plating current needed (A) i.e. 5x 0.0278 = 0.14A plating current}

4.6.3 Plating time estimation

Next, calculate the required plating time. The plating solution should deposit around 7 micros of copper per hour at 5 ASF (plating rate). For test wafer sample, the desired thickness is 28 micros, so we'll need to plate for:

{Plating Time = desired thickness (micros) / plating rate (micros/hr) x 60 min/hr
= (28 micros / 7 micros/hr) x 60 min Plating time = 240 minutes}. If this is too long for the user, he/she can try using with a higher current to reduce the time.

5. Plating operating procedure

5.1 Safety Precautions

1. Put on all Personal Protective Equipment (PPE), including a lab coat, goggles/face shield and plastic gloves before performing copper plating in the designated area.
2. The copper plating is subject to two main hazardous effects: electrical injury and corrosive acidic solution. Therefore, all below safety measures should be undertaken to avoid eye contact, skin contact and inhalation at any time.
3. To avoid electrical injury the user must not touch bare leads of the equipment with unprotected hands and always use plastic gloves when loading the wafer in the plating bath.
4. The additives used in the copper plating bath can produce corrosive vapor. Proper ventilation of the plating bath is ensured.

5. Rules of dealing with the plating chemicals are provided by chemicals manufacturer as material safety data sheet (MSDS) filed.
6. Never pour hazardous spent copper plating solution down the drain and destroy our environment. Copper plating waste solution should be collected and shipped to authorize company for proper treatment according to the Chemical Waste regulation.

5.2 Equipment booking

User has the booking on the equipment used and informs the responsible technician just an hour before operation.

5.3 Start-up procedure

The followings are activated first:-

1. Check the main power of the plating equipment is on.
2. Visually confirm that the plating bath is agitating with compressed air.
3. Line-up the plastic valve located at the inlet and outlet of the filtration pump
4. Turn on Stage#1 filtration pump by using the switch on the left side of front panel and turning the switch clockwise.
5. Turn on Stage#1 cooler pump first by using the switch on the middle of front panel and turning the switch clockwise.
6. Then turn on the chiller unit by pressing the switch on the right side of the unit.
7. Turn on Stage#1 temperature control valve by using the switch on the left side of back panel and turning the switch clockwise.

5.4 Wafer Mounting

1. Mount the wafer tightly to the special hanger fixture ("wafer fixture") as Fig.2 if for single side wafer plating without any through holes involved.
2. Mount the wafer tightly to the wafer fixture as Figure 3 if for wafer plating with through holes by using the two clips with cable wire provided such that the wafer is located at the centre of the fixture. Ensure that the electrical contacts of clips touching the conductive base layer at the wafer surface (Note: 4mm wafer edge width for clamping).

5.5 Plating Processing

1. Turn on the power supply A and set the current to 0.02A minimum value prior to dipping the wafer fixture into the plating bath.

Note: Failing to do this for few minutes will result in a seed layer copper that can easily be etched off & void in holes are inspected.

2. Attach the wafer fixture to the cathode bar of the plating bath. The wafer is then fixed and mounted facing the anode correctly for optimum plating uniformity.

3. Turn on Stage#1 agitation movement element by using the switch placed on the right side of back panel and turning the switch clockwise. The wafer fixture is agitated in a vertical position with gentle movement during plating.

4. Adjust slowly the power supply A to the desired current used if using wafer fixture as Fig.2.

5. Turn on also the power supply B if using wafer fixture as Fig.3 in double side plating and slowly adjust it to the desired current value for another side of wafer. Always ensure that the correct current is set on the individual rectifier output during plating.

6. After the wafer has plated for the required time, remove the wafer from the bath and rinse well under tap water in the rinse tank to remove most of the solution. Rinse the wafer under DI water finally to further remove the rest.

7. Blow dries the wafer fully with nitrogen gun to prevent oxide formation. The plated wafer is now ready for further processing.

5.6 Shutdown procedure

Once the user has checked the plating thickness is acceptable and can proceed the shutdown as follows:

1. Turn off Stage#1 filtration pump.
2. Turn off Stage#1 temperature control valve.
3. Turn off Stage#1 chiller unit first and then cooler pump later.
4. Inform the technician on this job finished.