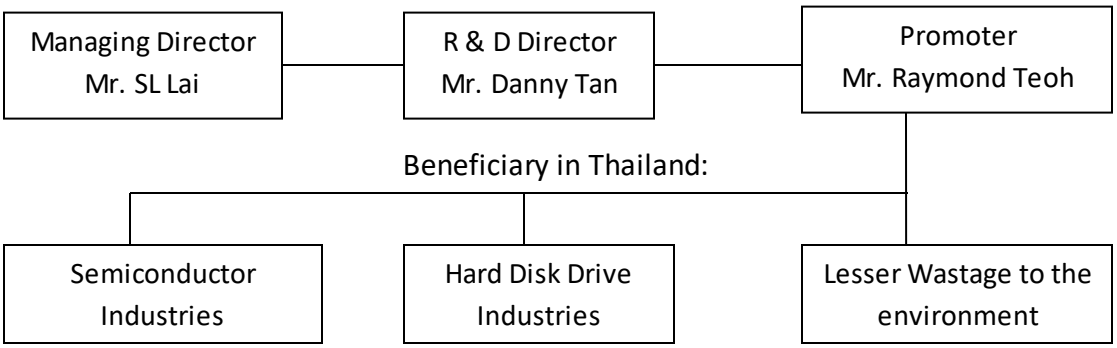
Corporate Social Responsibility

Corporate On Going Project:	Social Responsibility to Global Semiconductor Industries.
Social Responsibility:	Responsible to the green planet earth by reducing waste and recycling wire bond capillary.
Implementation:	Since the Year 2000
Presented by:	Raymond SL Teoh
Contact Telephone:	+66 89920 5585
Contact Email:	raymondteoh@ldtmicro.com

Organization Chart in Corporate Social Responsibility.



Content

Introduction

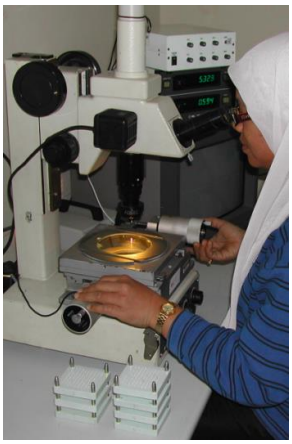
WB Capillary Cleaning / Refurbishing

Each year, the semiconductor industry globally discarded millions of used WB capillaries into the environment.
What a waste! REUSE REDUCE RECYCLE.

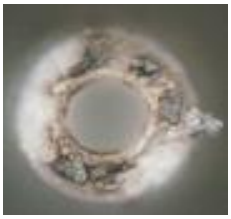
Your used capillary or wedges is still WORTH a premium ! Don't discard them.

At LD Micro, our WB capillary /wedges cleaning section can help to extend the lifespan by three(3) times. Our developed "proprietary processes" **without** using **chemical** is able to refurbish or recondition the capillary/wedges tip and ensure continue bonding quality. **MAXIMISE on your WB capillary/wedges tool life without compromising on the Wire Bonding quality**

Unplugging & Cleaning Process

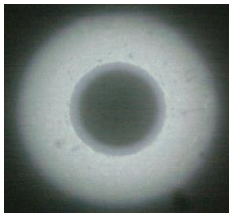


Final Inspection

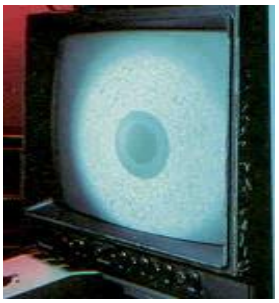


Before

Used Conditions :
- Plugged
- Dirty at orifice/inner wall
- Burnt mark caused by EFO

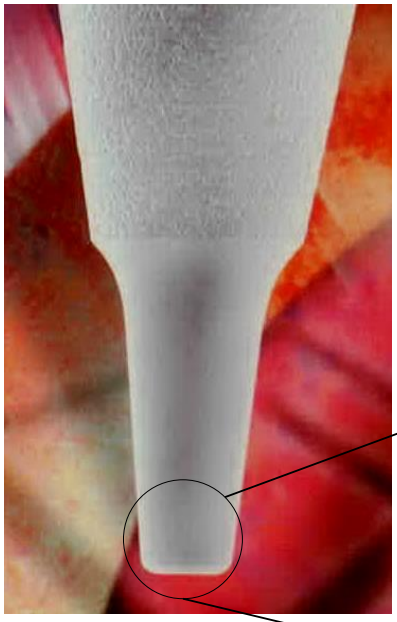


After



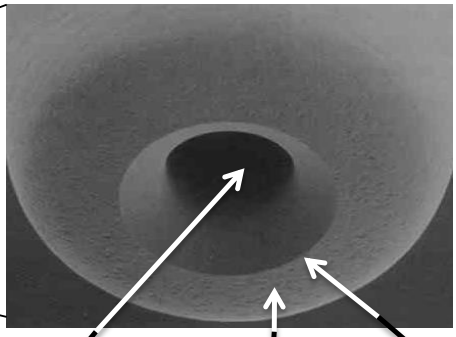
At 500x magnification

Basic understanding of a WB capillary



Typical narrow angle
“bottle neck” capillary

The Critical Areas :

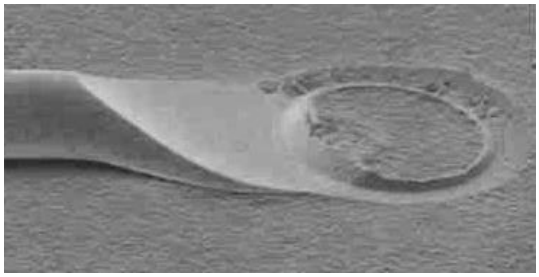


Wire Drag Hole (WDH)

Chamfer diameter
radius (CDR)

Outer Radius (OR)

Good ball bond



Good Second “stitch” bond

WHY Clean Wire Bond Capillary ?

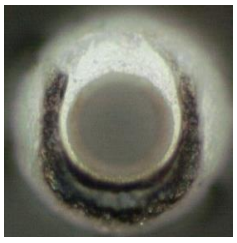
It recommended to clean or recondition the used capillary periodically even before the projected “lifespan”. Generally, all ceramic (Alumina) capillary toughened by high temperature sintering process are not easily worn-out through the normal wire bond process. The advantage, apart from ***tremendous cost saving*** are various:

1. From our record, unless broken a WB capillary can averagely be recycled three times against the normal lifespan where it is discarded e.g at 500K/Bond

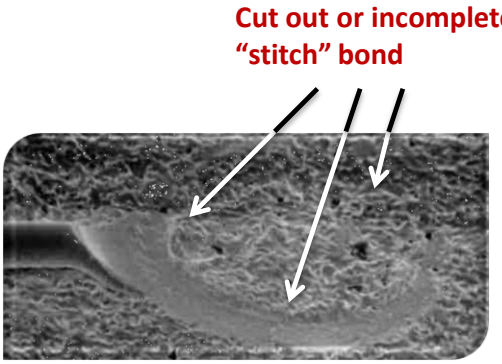
2. A regularly clean WB capillary will ensure continue good bondability.

   2.1 Clean inner wall will eliminated wire drag causing broken wires, irregular tail length that give inconsistent free air ball (FAB) formation.

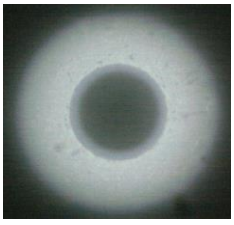
   2.2 **Remove** contamination or metallization at the ***chamfer diameter radius (CDR)*** area will **minimize** in poor “stitch” bond that result in reliability problem.



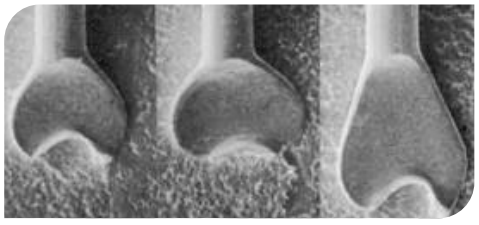
Metallization at CDR area



Weak/Chopped off second bond

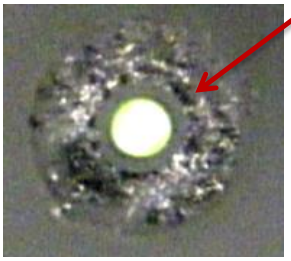


Clean CDR



Full contact “stitch” bond

Why **prolong or extended** WB capillary usage is not recommended?



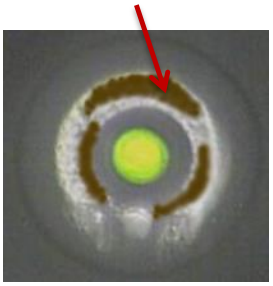
Before Cleaning

Full Contamination

Prolong wire bonding exceeding the recommended lifespan of 500k “touch down” will cause heavy (massive) metallization build –up (as shown).

Under normal wire bonding process, the capillary start to gather excessive contamination after over 300K bond (refer pg.5)

Cratering



After Cleaning

After properly cleaning and removing metallization there appears a cratering ring mark.

Such recess mark will cause loss in bond strength and inconsistent Free Air Ball (FAB) formation. Other typical characteristical problem arises are:

1.Lower bond (1st & 2nd) strength

2.Lower Young’s Modulus (Fig.3) E= $\frac{\text{Stress}}{\text{Strain}}$ } Elasticity “Pascal”

3.Higher Heat Affected Zone (HAZ)

cause by heat dissipation effects

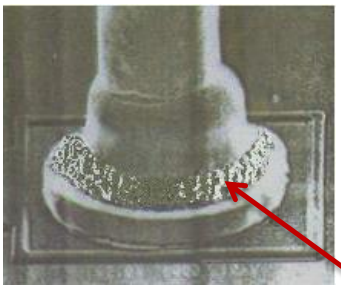


Fig.1

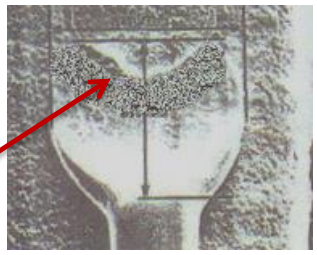


Fig.2

Weak bond area

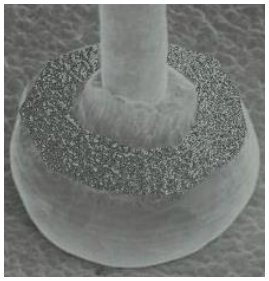


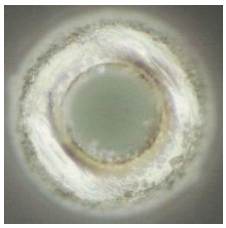
Fig.3

A badly worn-out capillary tip will definitely have impact on the young modulus value (pascal) esp. at the ball and stitch bond area. The wire pull datas will indicate the effects.

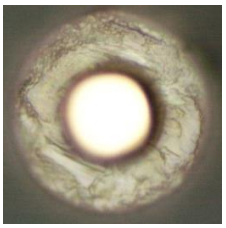
In other words, the wire has its elasticity value much reduced!

Progressive Stage * of Capillary Tip Condition during WB process

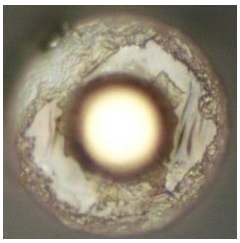
Before Cleaning



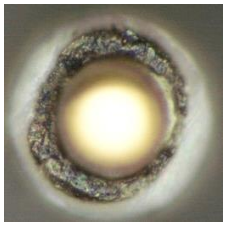
At 50K Bond



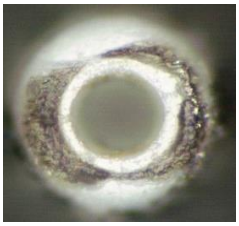
At 100K Bond



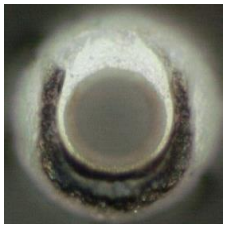
At 200K Bond



At 300K Bond



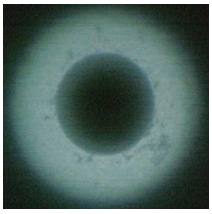
At 400K Bond



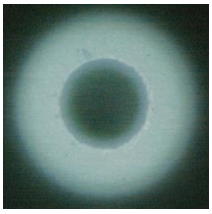
At 500K Bond and above

Note: Magnification at 500X

After Cleaning



1st Cleaning



2nd Cleaning

Note : Not much significant difference between 1st & 2nd cleaning. Only stain mark left (Non 3D)

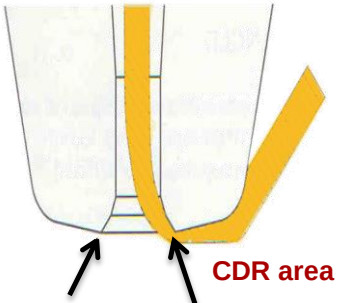
Obviously, even at the initial 50k “touch down” the tip start exhibiting collection of “dirts”.

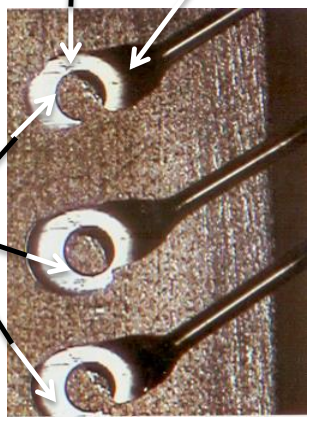
No doubt that the physical condition of the capillary tip specification is remain unchanged i.e. without any sign of worn-out resulting in excellent ball formation. The concern is the contamination/metallization accumulated at the tip.

Cleaning of the used capillary eliminate or minimize the particle (dirt) that goes into the wire bond process(es) that can cause also delamination problem.

* Photographic reports extracted from Sumitomo Metals, Shanghai

How does the "dirts" or metallization get accumulated at the tip of the capillary?



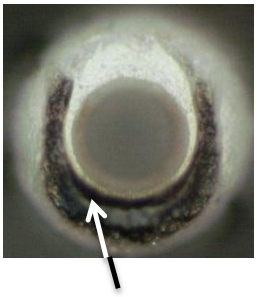


Upon completion of each wire bond process particularly the "stitch bond", the wedge –off portion "A" tends to gather some broken scale off gold or even copper wire from the surface.

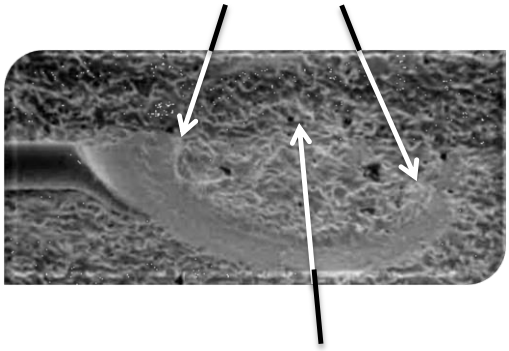
Similarly, there is also a peel-off portion from the tip CDR area at A.

These "B" of dirts will eventually burn-out by the EFO sparking and the process goes on and on.

Result : Heavy metallization causing very poor stitch bond



Accumulated metallization
Caused by "after burnt"



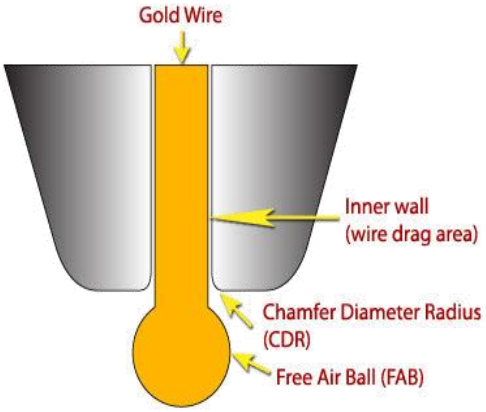
Break Up

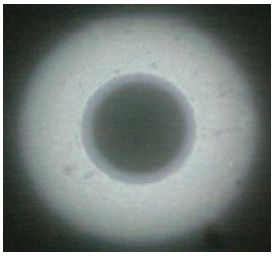
What is a "Good Condition" Capillary?

All Wire Bond capillary is subject to normal wear & tear upon usage up to an average Of 400-500K / bonds. However, most of the time, the wire bond conditions deteriorated even before the projected lifespan mainly due to contamination / metallization.

There are two (2) critical areas of which a capillary is considered "good condition"

1. The inner wall area must NOT be dirty that give "drag" to the wire feed area causing :
   a) Breaking wires
   b) Irregular ball formation
   c) Irregular wire loop height
2. Burn mark at the tip will cause contamination to the air ball resulting in poor ball bond and second "stitch" bond.
3. The Chamfer Diameter Radius (CDR) must be cleaned and sharp.





Advantage

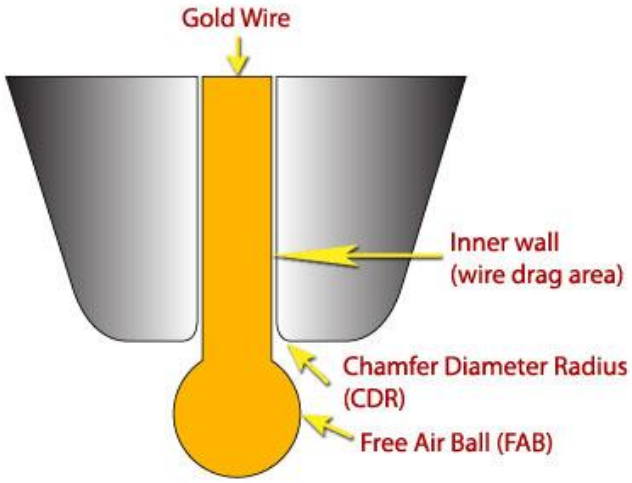
Upon recycling which involves unplugging, cleaning & washing, the capillary is reconditioned to its useful performance & maintaining the wire bonding quality. The lifespan can also be extended by at least three (3) times . It only cost a fraction of the new one price to recycle. ***Result is tremendous cost saving !***

With reconditioning, you can cut cost but not the QUALITY !

WB Capillary Clean with a **DIFFERENCE**

The traditional method of cleaning dirty WB capillary is by applying very strong acid which has combine formulation of Hydrochloric Acid HCL and Nitric Acid HN03 commonly called Aqua Rega. This is the only way to remove “dirts” esp. inside the wire drag hole of diameter 0.8,1.0,1.2 or 1.5 mils

However , this method, as in the past, has caused numerous concerns and complaints as to how thorough can the cleaning be done. As we are fully aware that capillary being ceramic (Alumina) has its porosity characteristic which means it can absorb moisture and in this case the acid. The acidic residue might corrode the gold or copper wire thus weaken it and causing reliability problem.



How we do it **DIFFERENTLY**?

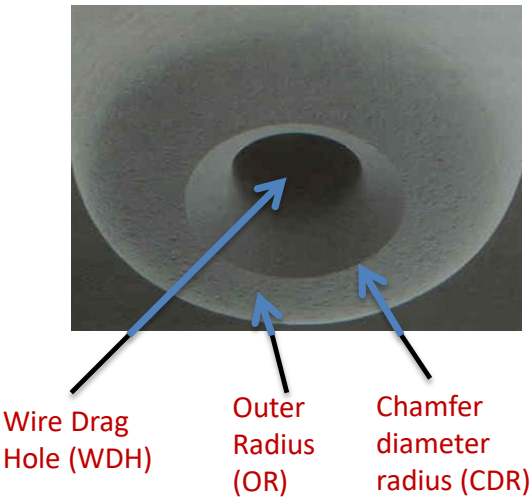
Frankly, the most difficult area to clean is the Wire Drag Hole (WDH) as it is the smallest diameter averagely 25um (0.025) or 1 mil. Most user start to replace the capillary upon seeing the symptom of irregular ball size, looping related problem or even frequent breaking wires. The problem is obvious!

Over the years, at LD Micro we have developed the ultra fine grinding machine capable of producing probes as fine as 6 microns that is use in wafer testing or mapping operation. With this capability, we can profile grind the probe to the capillary specification for easy dirts removal.

The tip surface can be easy clean using mild alcohol (IPA) and rinse in DI hot water ultrasonically.

Also critical is the final inspection of the cleaned capillary using a 400-500X magnification high inspection microscope. This microscope will also have the CCD attachment for inspection report and record.

High Power Microscope



It pays to recycle

Improve on your **competitive advantage** by recycling your used WB capillary.

Benefits are plenty!

1. Cost Down Impact

Tremendous cost saving!

Assumption :

1)Average purchase price of the WB capillary USD4.50 or THB157.50 each and monthly assumption of 10,000pcs

Total cost = USD4.50 X 10,000

= USD45,000.00/month

2) Cleaning cost approximately 25% of the purchase price

Which means a saving of USD 33,750.00/month OR if the annual consumption is around 120,000pcs then the total saving will be USD405,000.00 per year.

Note : A used capillary can be recycle up to three (3) times without affecting its bonding quality.

2. Improve wire bonding reliability

A clean capillary guarantee good ball bond formation and excellent stitch bond. Minimize bonding failure thus improving on the output yield.

3. Reduce contamination

Reduce contamination in wire bonding and minimize the **delamination** problem caused by the “ metallization” chips.

4. Environmental Friendly

As ceramic material is not bio degradable and it important to reduce its usage. Each year the industry discarded millions of used capillary into the environment. Protect our environment

SAVE MOTHER'S EARTH