APL
HOFSTETTER
PCB GmbH

Immersion tin refresh, a high efficient and cost reducing process

iSn

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Who is APL Hofstetter PCB GmbH?

APL Hofstetter PCB GmbH is a service company [job plater] specialized in immersion tin (iSn), iSn refresh and FinalClean (ENIG/ ENEPIG). The location of APL Hofstetter is in Lörrach (Germany). APL Hofstetter cooperates with all kind of printed circuit board (pcb) manufacturers, electronic manufacturing services (EMS)-industries, trading companies (national/ international), and worldwide original equipment manufacturer (OEM).

What is immersion tin (iSn) by APL Hofstetter?

Immersion tin by APL Hofstetter is a "high quality iSn layer" with a very strong performance. The coating is very dense and fine crystalline with an excellent corrosion resistance. A multiple solder ability and a shelf life up to 12 month is given. The background is 20 years iSn know-how, special equipment, process technology and reliable process chemistry (Stannatech® 2000 H).

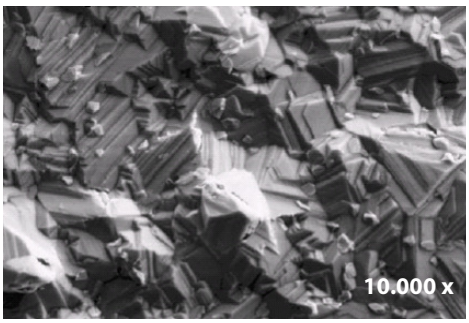

Fig. 1: Copper + iSn

What is iSn refresh process?

With our special process technology we can bring a "bad working iSn layer" back again in a good solderable condition. The refresh is general a "tin on tin" progress, a previous tin stripping is not necessary. Our success rate, viewed over the past ten years, is bigger than 95%.

What are intermetallic phases?

Intermetallic phases are formed by diffusion of at least 2 output metals (here copper and tin). The copper diffuses into the tin layer, two phases are formed Cu_6Sn_5 (tin rich) and Cu_3Sn (poor in tin). The intermetallic phases are formed already during the deposition of iSn. The growth of the phase depends on time and temperature, which is a natural physical process. After the maximum storage time, copper can diffuse to the tin surface through the growth of the intermetallic. Copper oxide can occur, thereby the pcbs will show a bad or even not solderable condition.

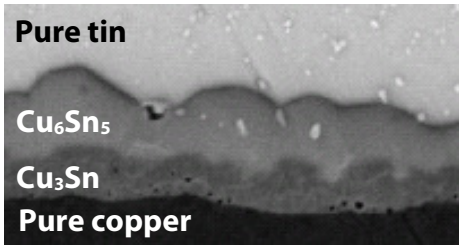

Fig. 2: Layer structure Cu/ Sn

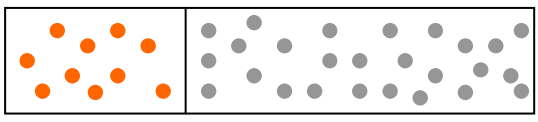

Fig. 3: Schematic description of the diffusion (left Cu, right Sn)[1]

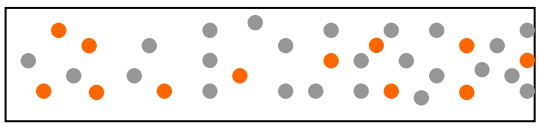

Fig. 4: Schematic description after the diffusion process[1]

How does the process work?

During the iSn refresh process copper contaminations, on/ or in the original iSn layer, intermetallic phases and undefined tin oxides are removed and/ or dissolved. In parallel a fresh, pure tin layer (>0.1 - max. 0.3 µm) is deposited especially on such areas where copper is leached out. We speak in such a case from a "self-healing effect".

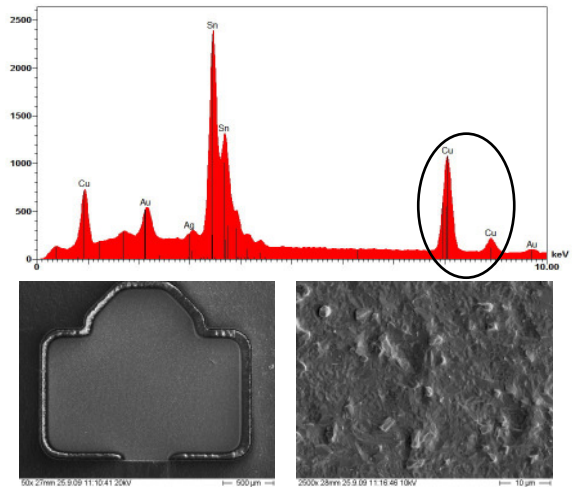

Fig. 5: Before iSn refresh[2]

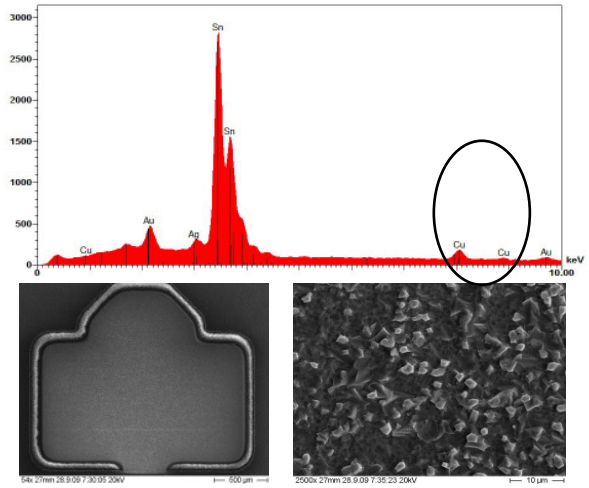

Fig. 6: After iSn refresh[2]

Why and when is the iSn refresh process used?

The solder and press fit surface iSn can generally be refreshed under industrial conditions. The iSn refresh process is economical, very effective and prevents the scrapping of the pcbs. It is from the European industry extensively tested and an approved process[2,3,5]. It is carried out daily for several European electronic companies. iSn as a final finish is subject of ageing processes, that lead to reduced solderability increasing storage time. Maximum storage time for iSn pcbs is determined to 12 months in the pcb specification. Many suppliers and competitors also guarantee solder ability only for a 6 month period after final finishing at the pcb supplier.
Suppliers of iSn electrolyte claim a prolonged solder ability for iSn if a "refresh process" is carried out. By this, pcbs with iSn are processed a second time in the iSn-line at higher speed, so that Sn-Oxides and Cu_xSn_y intermetallic phases could be removed.

The refresh is carried out if:

- The solder ability is not sufficient for multiple soldering processes
- The original iSn layer is overaged (>6 resp. >12 month) / overlay
- The iSn thickness is below 0.80 µm/ 1,00 µm.
- There was a copper redeposition on iSn at the first tinning process
- The ionic contamination is >1.55 µg/cm² NaCl-Equivalent

  (due to poor rinsing quality at the first tinning process)
- The original iSn layer is manipulated (e.g. brushed)

Performance tests Fraunhofer ISIT:

- Performance test of refreshed pcbs were made by Fraunhofer ISIT (2009/2014)
- 3x reflow resp. 2x reflow/ 1x wave soldering were performed (SAC305 Lot; Peak ~245 °C)
- The refreshed pcbs show all very good wetting results, via-filling = 100% (acc. to IPC-A610D 75% via-filling)
- With the iSn refresh process, overaged pcbs can be verifiably transformed into a solderable condition[2]

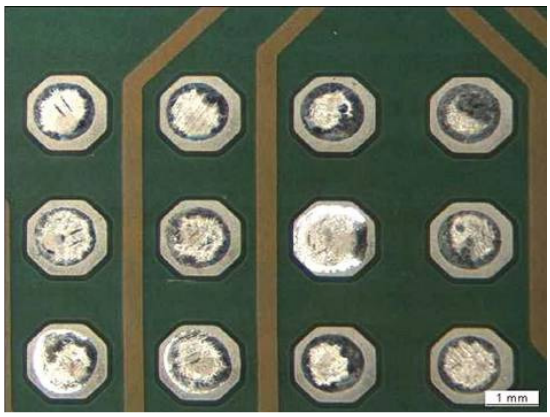

Fig. 7: ½ year storage + refresh after 3x reflow and wetting by wave soldering[2]

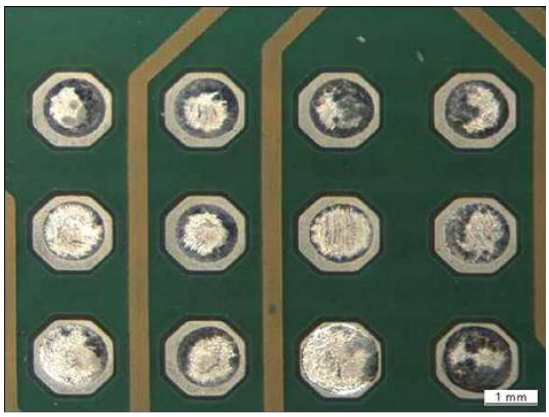

Fig. 8: 1 year storage + refresh after 3x reflow and wetting by wave soldering[2]

What are the benefits of the iSn refresh process?

The iSn refresh process shows a lot of benefits which are listed below. The benefits are classified in technological, environmental and economic benefits.

Technological and Environmental Benefits

- The iSn refresh process is approved[2,3,4,5] and used in Europe from the pcb-, automotive-, telecommunication-, OEM- industries as well as from many national/ international trading companies
- It can keep pcbs with poor iSn from being scrapped
- It is very efficient with a yield ≥95%
- It is quickly available. If necessary, smaller pcb quantities are back in 1-2 days at the assemblers place
- The CO_2 footprint is relatively small, because the pcbs do not have to be flown around the world
- The cleanliness of the refreshed pcbs can be reduced with our rinsing technology to <0.5 µg/cm² NaCl-Equivalent

Economic Benefits

- The iSn refresh process has a very high cost saving potential. The refresh price is about 10% less in relation to the total pcb costs
- In nearly >85% of the refresh jobs the refresh process is much cheaper than to produce and coat new pcbs
- Example cost comparison: new purchase of 6 fold multilayer (ML-6) and 4 fold multilayer (ML-4) in comparison to the iSn refresh process
  (Dimensions: 233.4 x 160.0 mm; amount: 1,000 pcs)

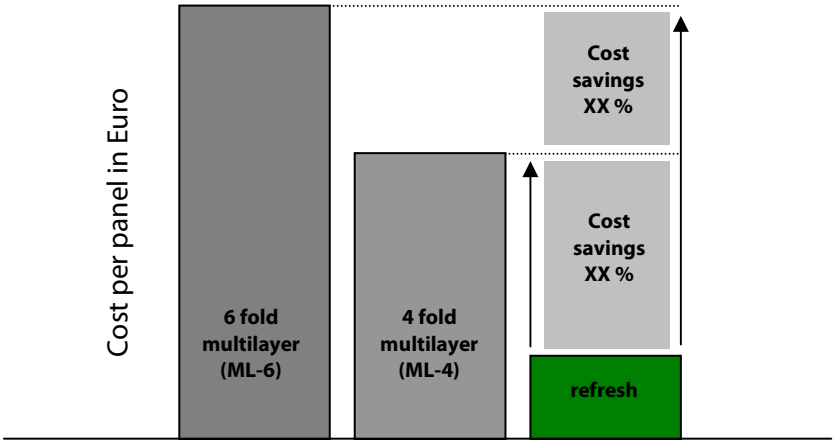

Fig. 9: Description of the cost relations

Further information

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[2] Fraunhofer ISIT performance test: 2009/09_394956 and 2014/11_397142
[3] Atotech Deutschland GmbH, PS report no. 060411 (FIB refreshed panels after 1 year storaged.pdf)
[4] PLUS 10 (2008), 2111-2114 (plus refresh dk.pdf)
[5] Bosch Automotive Electronics (Bosch_APL_iSn_Refresh_100121.ppt)