5TH ELECTRONIC MATERIALS, PROCESSES AND PACKAGING FOR SPACE EMPPS WORKSHOP

PCB reliability 2014

NOORDWIJK, THE NETHERLANDS 20-22 MAY 2014

Poul Juul, HYTEK Sofievej 61 DK-9000 Aalborg, Denmark

hytek@hytekaalborg.dk, www.hytek.eu

A PCB is a very complex component but a lot of designers just see it as a simple ”green board”.

This can lead to insufficient requirements to the PCB manufacturer and in combination with focus on low cost result in a lot of hidden/latent defects. The increased use of high density and layers in the PCBs leads the PCB manufacturer to the limits of the manufacturing processes and thereof increases the risk for defects.

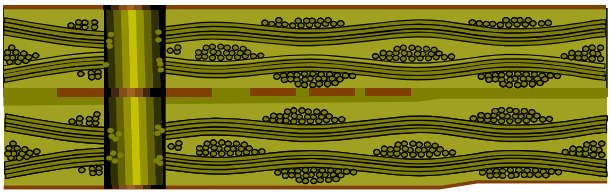
Furthermore elements such as the RoHS directive and thereof implementation of lead free soldering processes results in higher peak temperature (+30°C) and longer exposure to high temperature in general. The combination of higher temperature and longer process time in soldering processes result in significantly higher thermal stress to the PCB laminate and plated holes.

The scope of this paper is primary to focus on ICD (Inter Connect Defects). The root cause for ICD can typically be related to a combination between the laminate type and quality, the hole drilling process and the plating process. Due to the high number of process steps in the copper plating process a tight control of the parameters is very important to secure a reliable connection between innerlayer and hole plating.

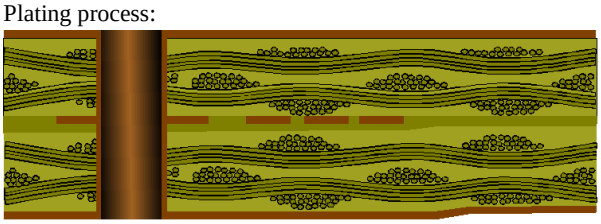
Plating process

Example plating and etching process:

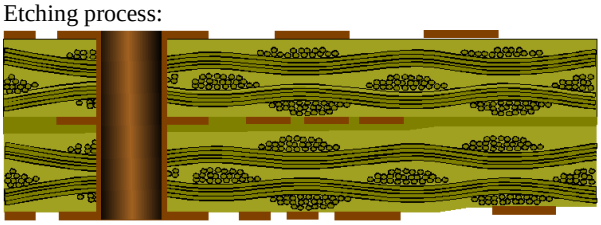
Hole drill:



Plating process:



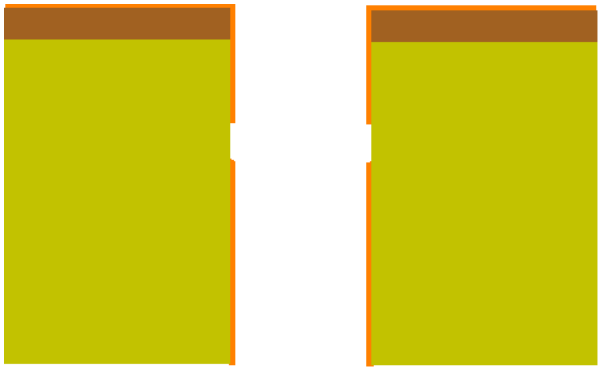
Etching process:



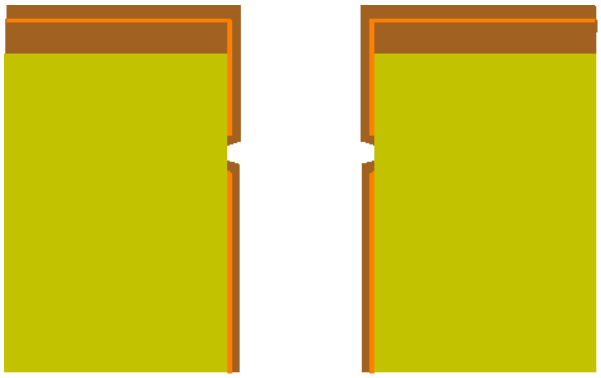
Example plating process defect:

- De-smear process
- Rinse and pre-conditioning

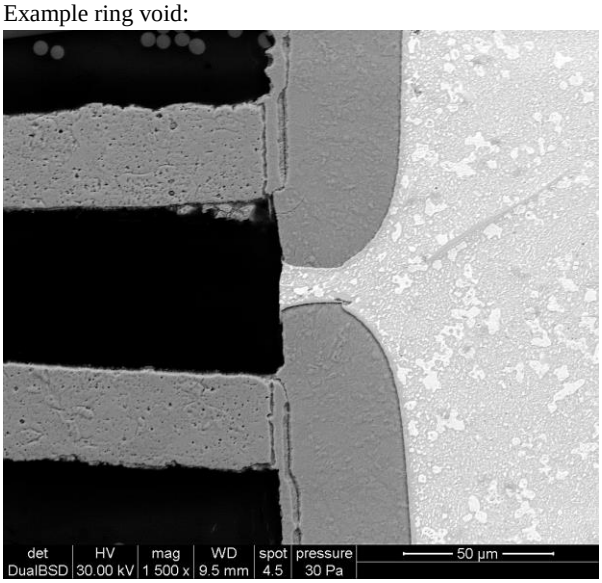
- Electroless plating process (e.g. Copper)
    - Ring void e.g. caused by insufficient cleaning, activation or electroless copper plating process



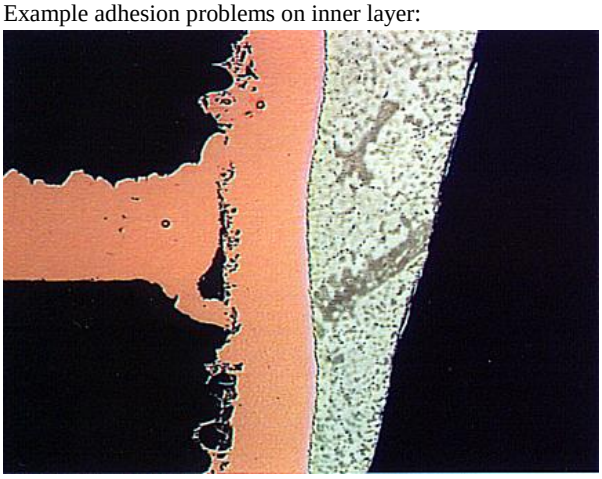
- Rinse and pre-conditioning
- Electrolytic plating process



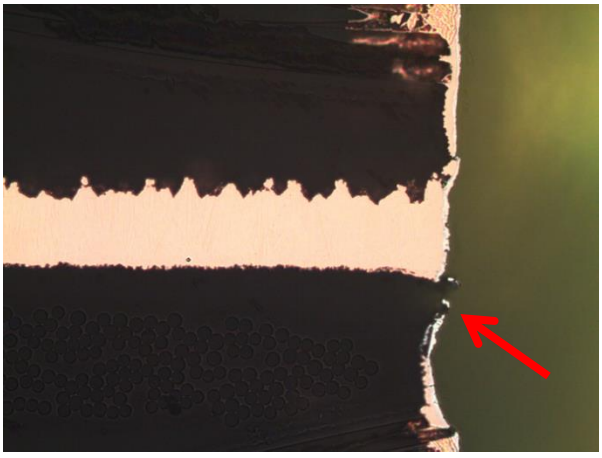
Example ring void:



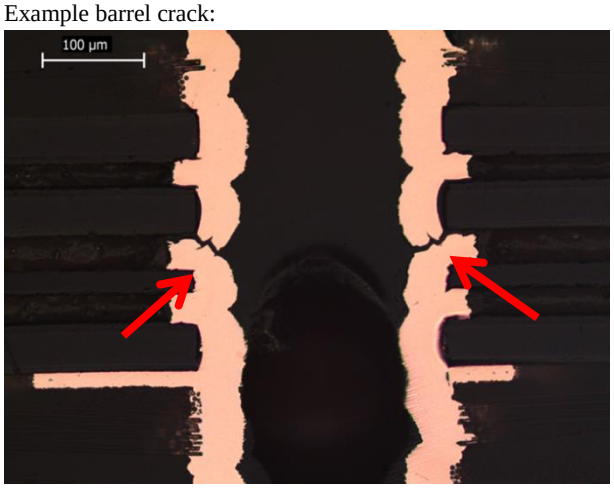
Example adhesion problems on inner layer:



Example insufficient plating coverage:



Example barrel crack:



- Panel- vs. pattern-plating

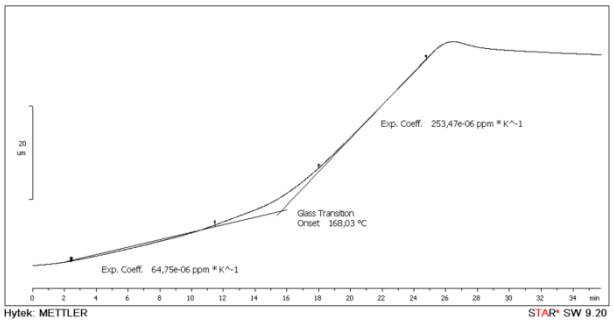
Most of the ICD can be related to the plating process; but other elements can have influence on the plating quality especially the laminate and prepreg.

The following examples can direct or indirect result in ICDs:

Base material

- Tg (Temperature Glass Transition)
  - Tg too low for the manufacturing processes (PCB or Assembly) or for the end user environment
- CTE (Coefficient of Temperature Expansion)
  - CTE too high for the manufacturing processes (PCB and Assembly) or for the end user environment

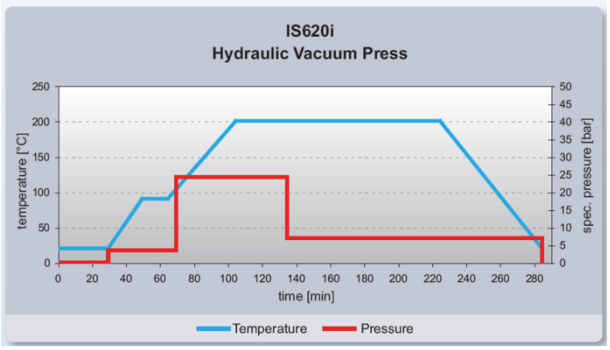
Example Tg and CTE measurement:



Laminate process

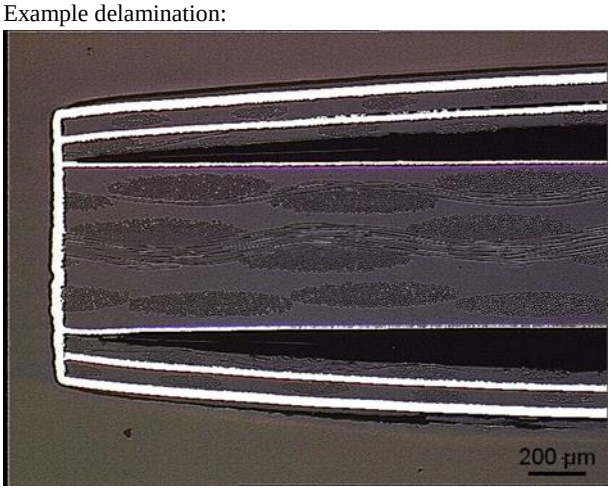
- Panel size and stacking
- Press parameters

Example press parameters (Isola):



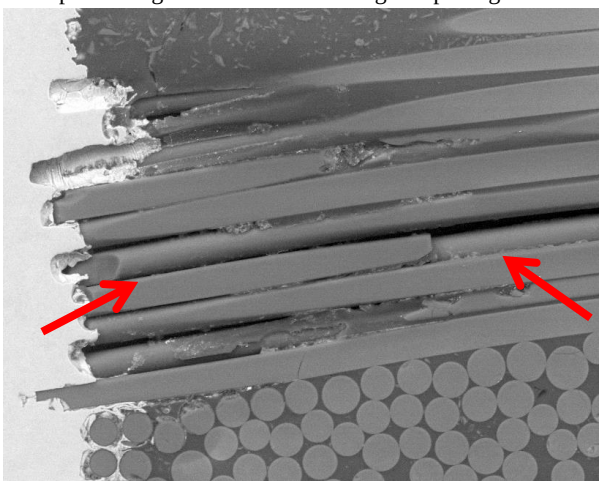
- Delamination

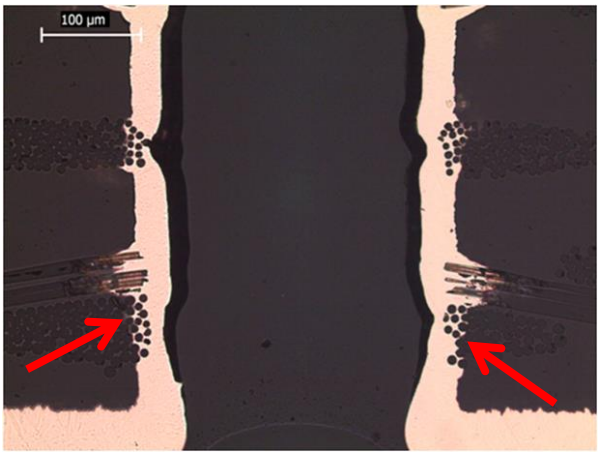
Example delamination:



- Woven glass quality
  - Woven glass type and coverage does not meet requirements for e.g. CAF resistance (Conductive Anodic Filament)

Example loose glass fibers after drilling and plating:





- Fillers
    - Fillers e.g. inorganic, impacts the drilling process and thereof risk for plating defects

Drilling process

- Number of hits
    - The number of holes (hits) a drill bit can produce depends highly on the material through which it is drilling
- Re-sharping procedures
    - How many times can the drill bit be re-sharped and which drill parameters should be used for re-sharped drill bits
- Drill parameters
    - Feed rate and spindle speed shall meet the drill bit type and material

Summary:

To minimize the risk for ICD it must be assured that all process parameters (resin cure, de-smear process, cleaning/rinsing/etch process, activator process and electroless plating process) are within the specifications and controlled effectively e.g. with real SPC (Statistical Process Control). Al production equipment and elements (e.g. water quality/treatment, chemicals, machines) must be in control.

But a lot of defects can be related to insufficient “know how” of personnel and operation mistakes (material science and laboratory analysis). Therefore it is very important to focus on the human resources in the PCB manufacturing processes.