TIE 2012 Workshop
Up to Date Issues in
Electronic Assembling Technologies
26th April 2012, Sibiu, Romania

Application of Safety Bonding Methods to Gold Wire Bonding to Improve Yield and Reliability

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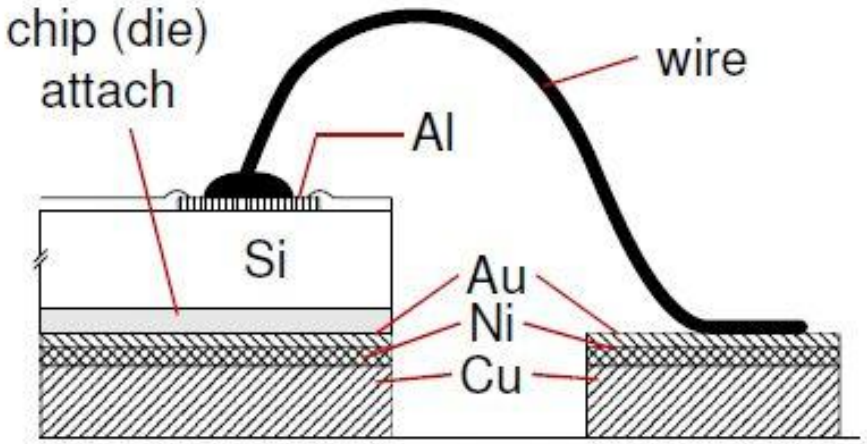
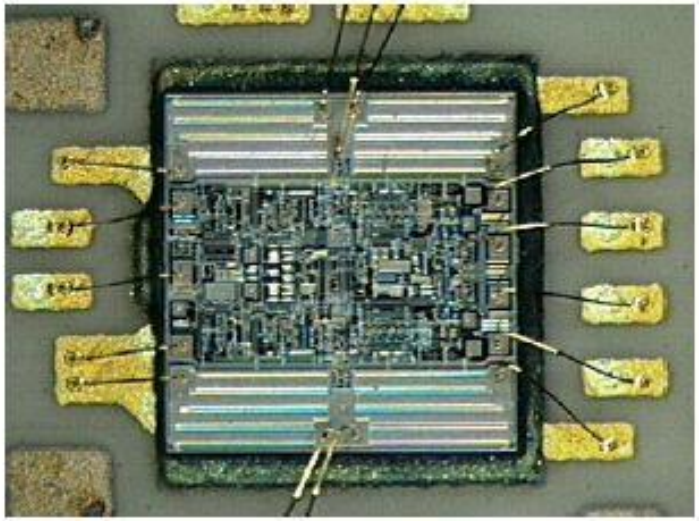
WIRE BONDING

1. Direct chip soldering or gluing onto the chip support

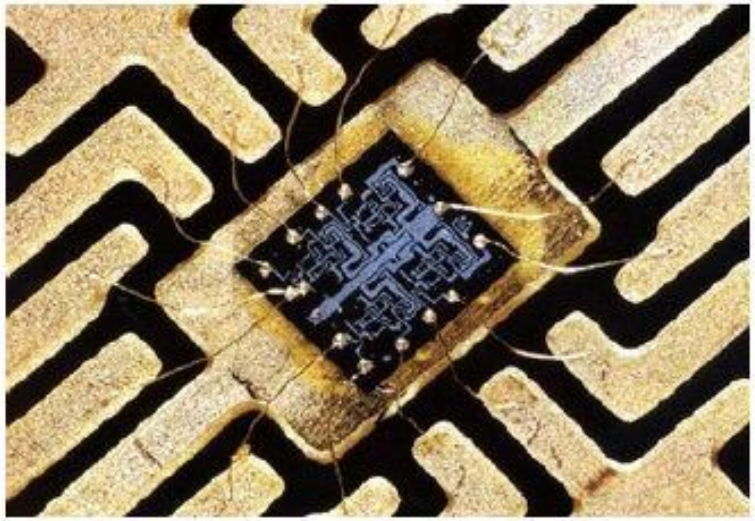
2. Electrical contacts with wires



Mounting onto chip support (PWB, hybrid circuit)



Mounting onto leadframe (for packaging)

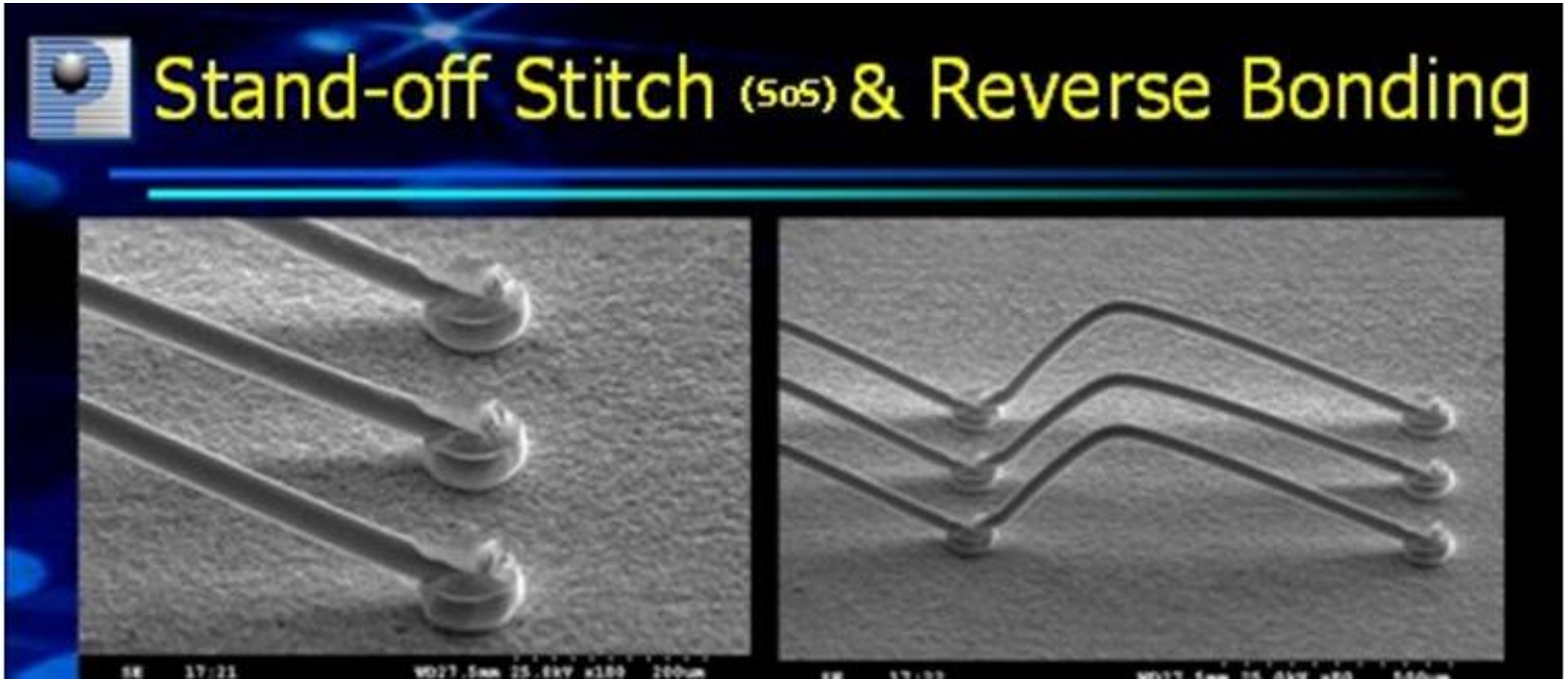


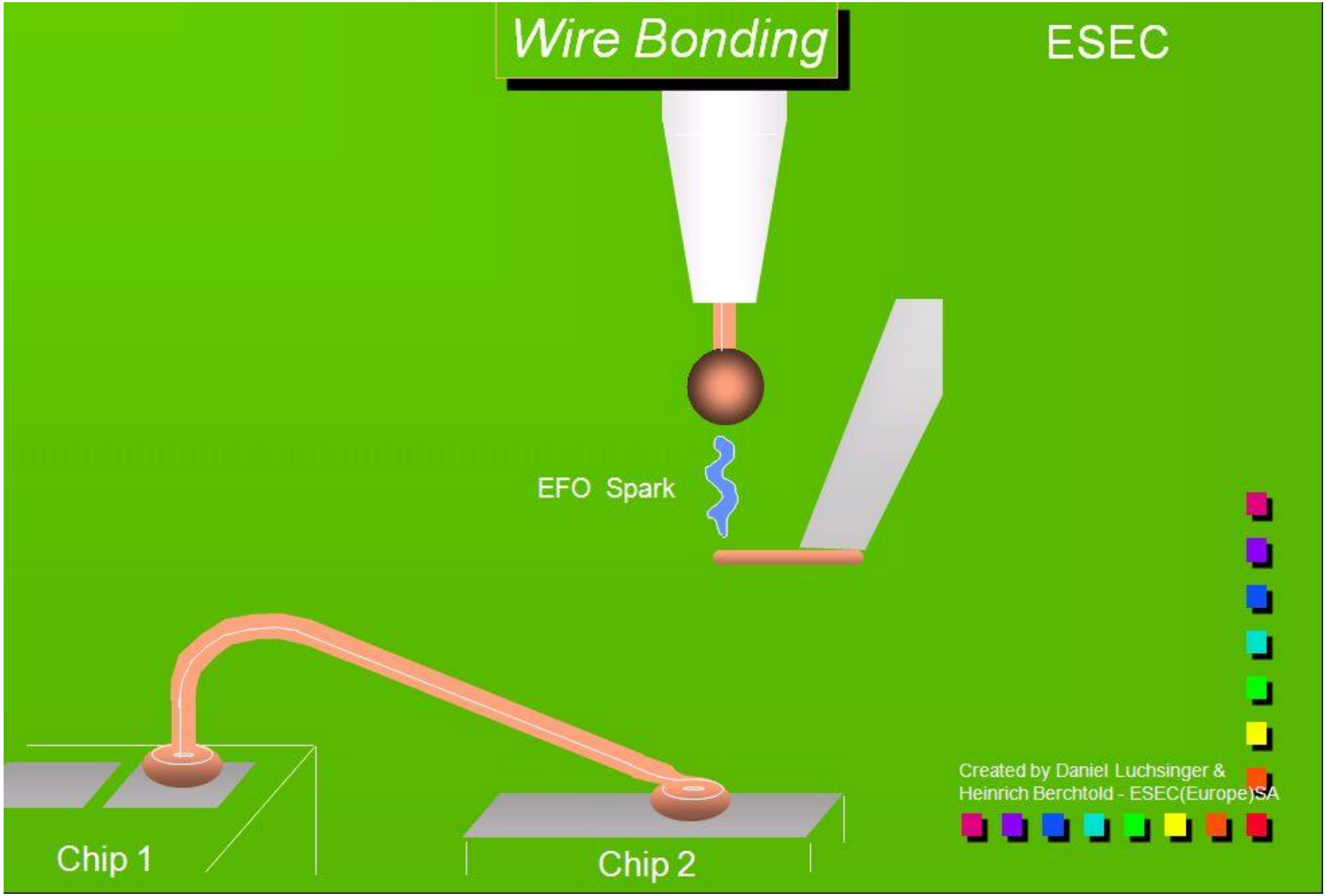
WE CONNECT CHIPS AND SYSTEMS

How to make strong and reliable wire bonds ?

Strong wire bond interconnects are needed for industries with high reliability requirements, e.g. for implantable medical device manufacturers, automotive, telecommunications, aerospace and defense.

Stand-Off-Stitch (SOS) technique is the most common method to increase bond reliability. Its essence is a stitch bond on a bump previously made by ball bonding. Other safety bonding techniques, like ‘security wire’ and ‘**reverse bonding**’, as well as, their benefits are discussed.

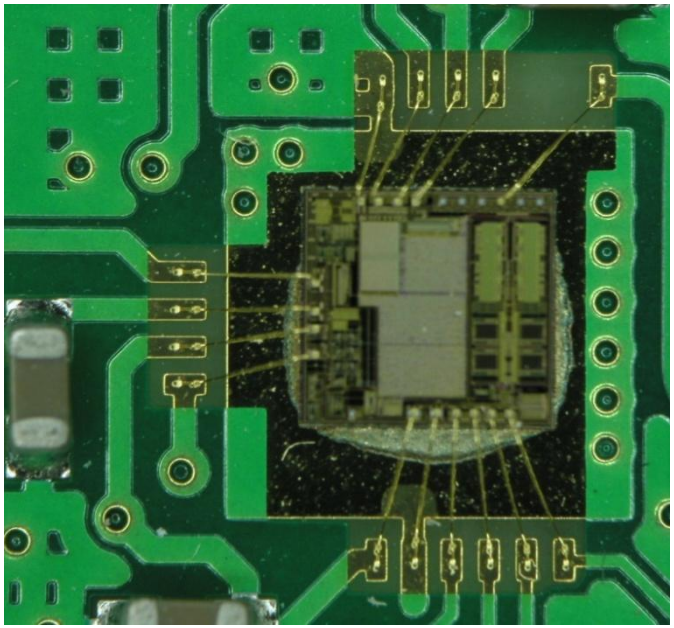


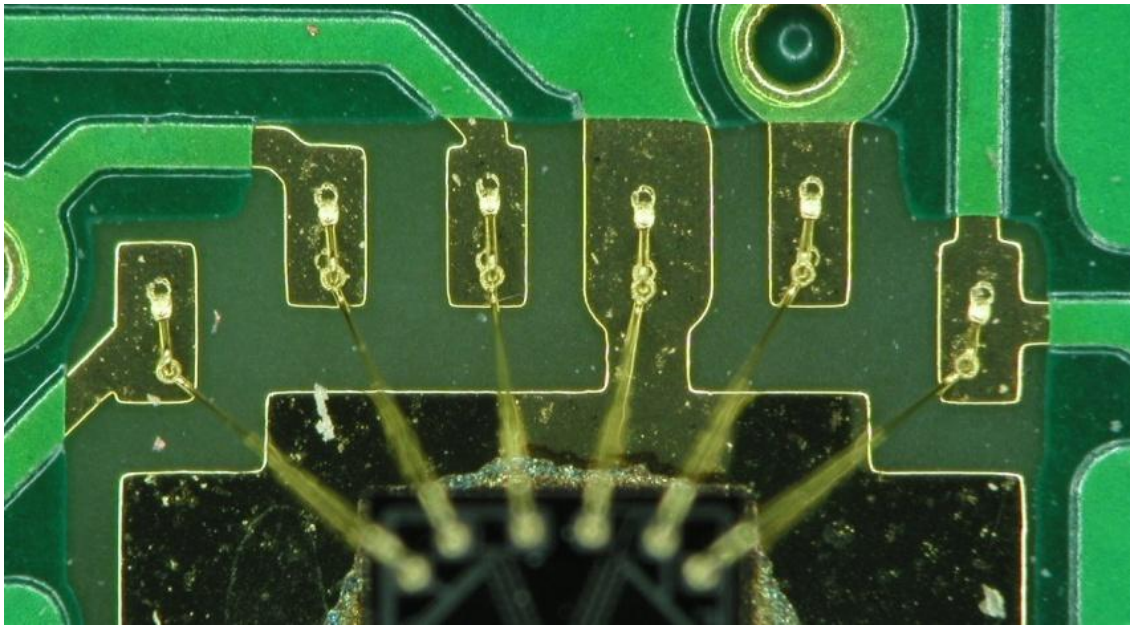


Different thermosonic bonding methods

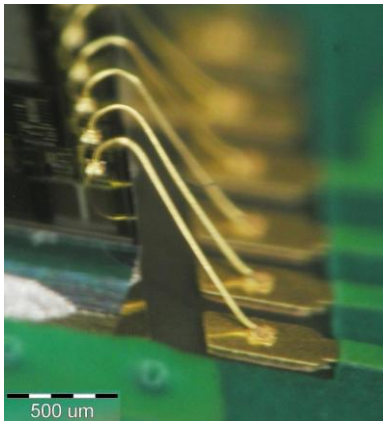
From the possible bonding and joining processes, in units of high reliability, different thermosonic wire bonding methods are used to make the connection chain from the integrated circuit (IC) or sensor chips to the PCB (Printed Circuit Board) substrate, then from the substrate to the terminals of the case, and finally the terminals are usually laser welded to the flexible cable, which connects the unit to the system.

Figures show the IC and the sensor chips on the PCB. Usually, ball bonds are made to the chips, and, in these cases, safety bonds to the substrate.

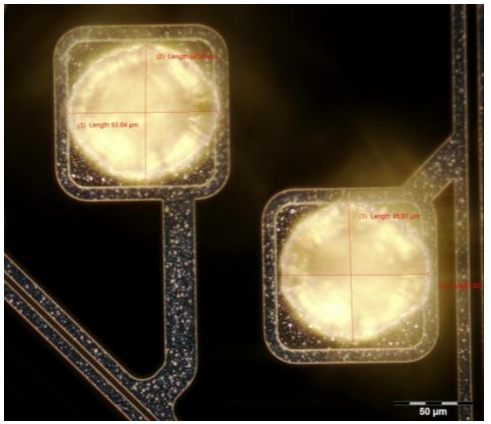


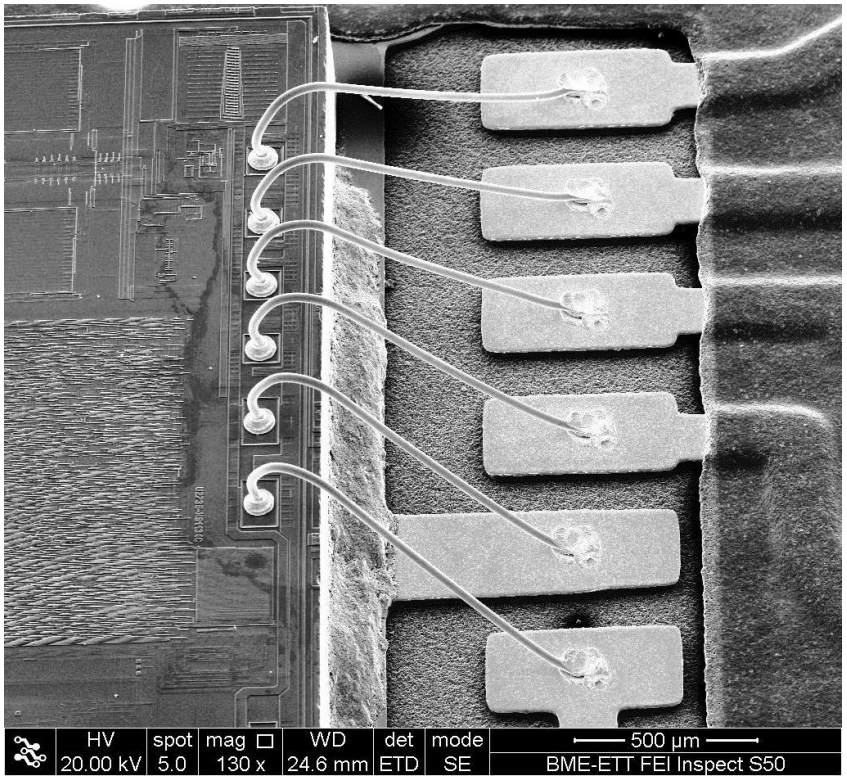


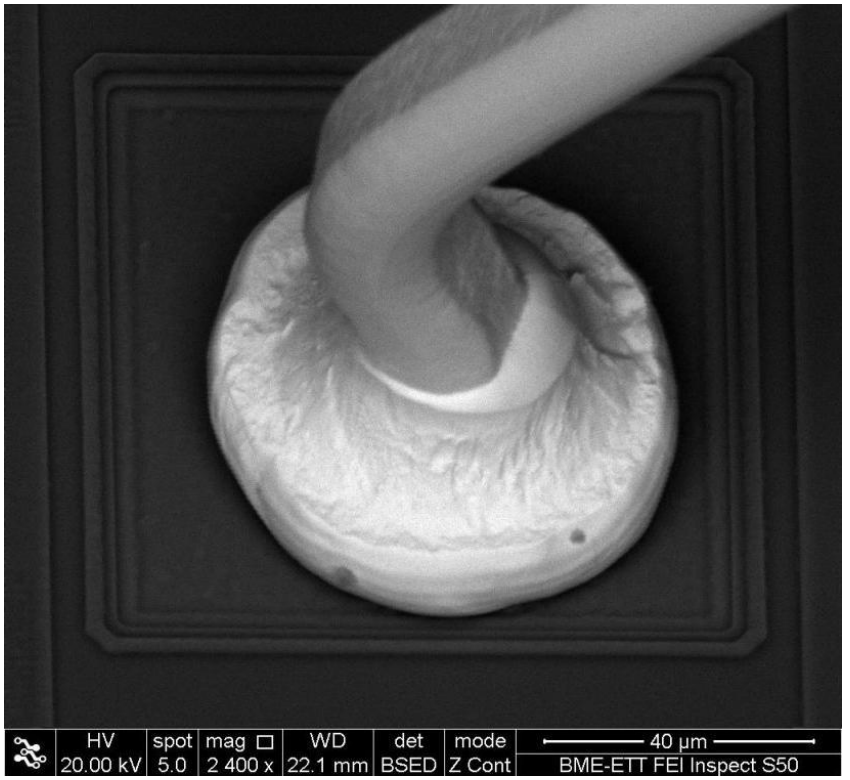
Thermosonic balls bonds on the chips



Usually thermosonic ball bonds are made to Al contact pads of the IC or sensor chips. Optical micro-scopic photos and SEM (Scanning Electron Microscopic) images provide good possibilities to study the structures of the bonds.







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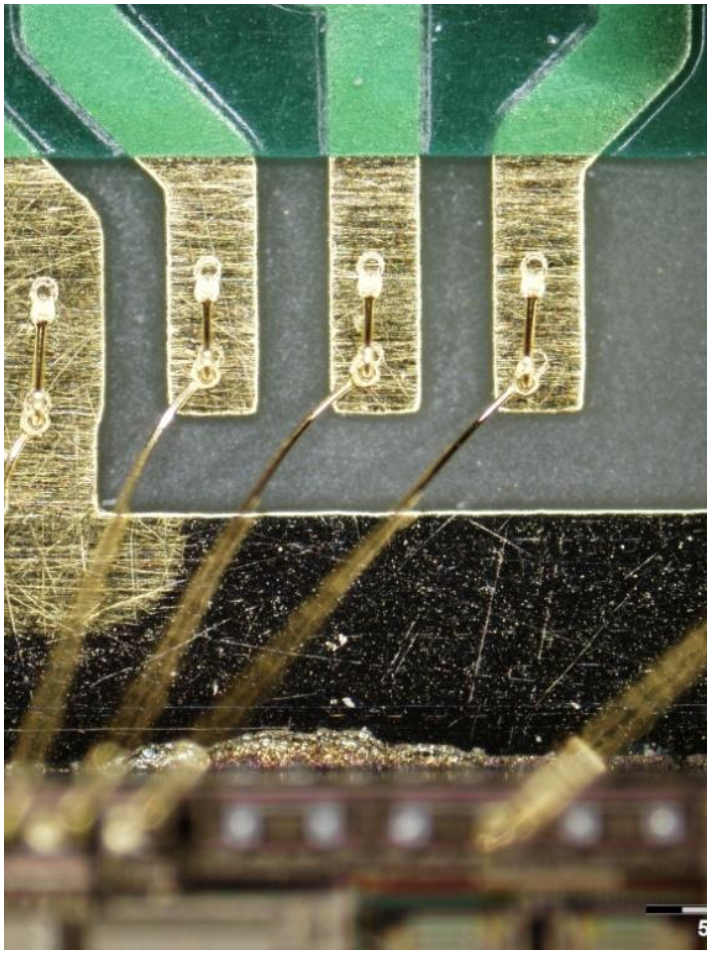
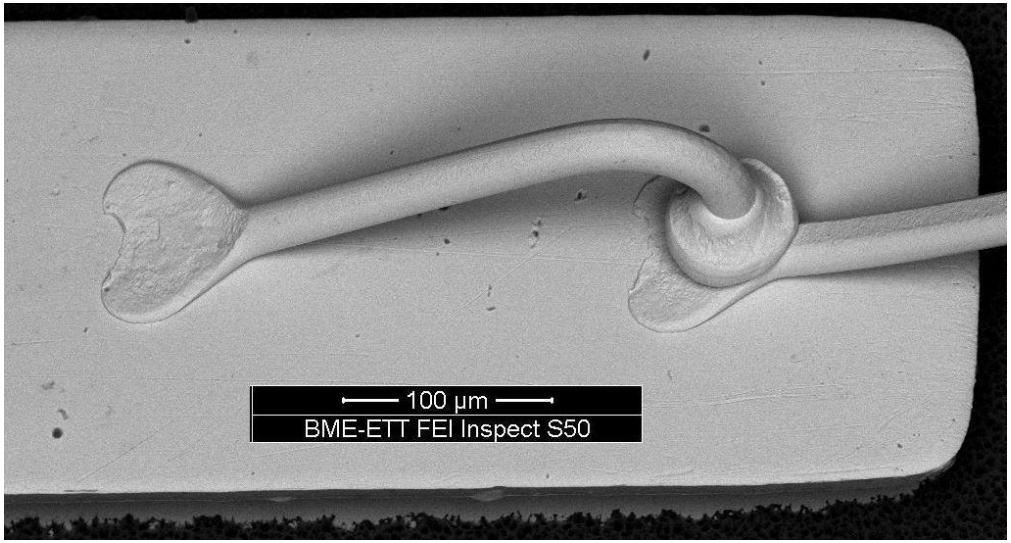
Security or safety bonds on the pads

Security or safety bond is created with the capillary tool of the ball bonder by placing a ball bump over the crescent of the wedge bond on the pad of the substrate (PCB) to seal the disturbed metal, thus improve reliability.

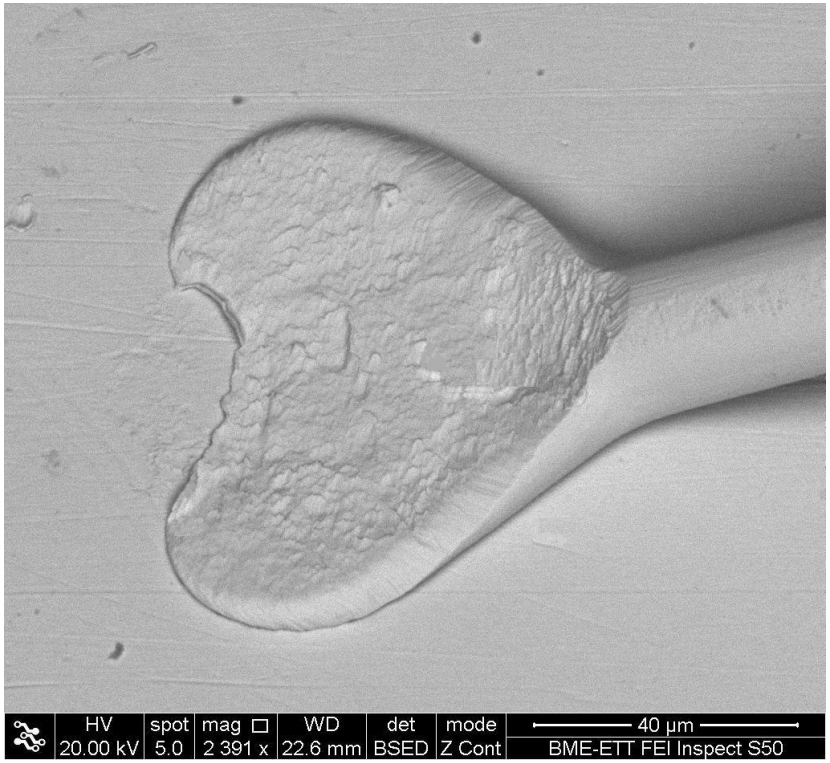


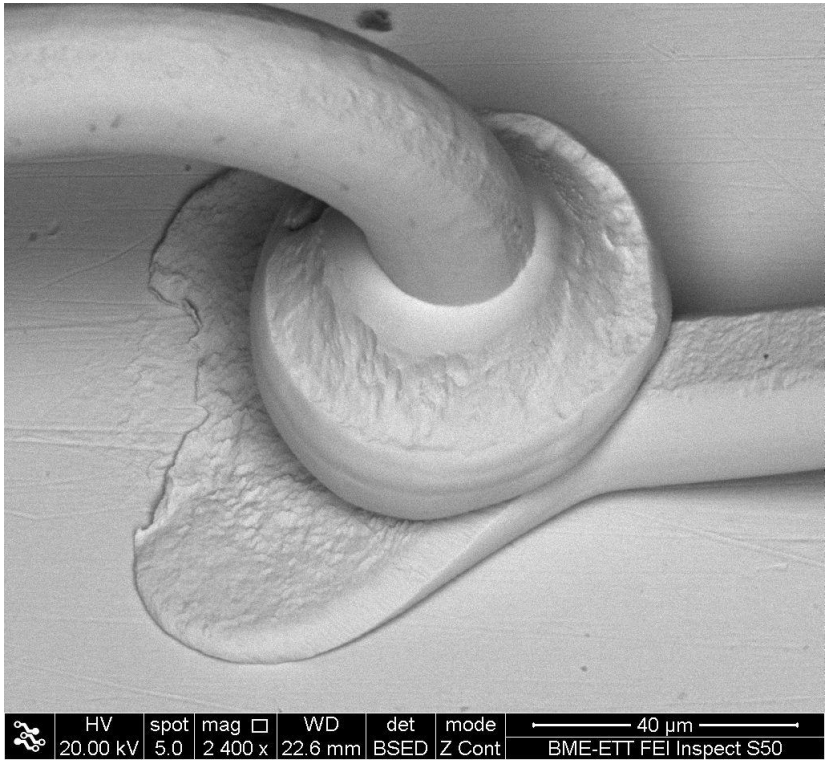
SEM images of a security (or safety) bond on a PCB pad



The PCB pad is covered by ENIG: Ni can be detected through the Au.

Element	at.%
Gold	86,92
Nickel	13,08





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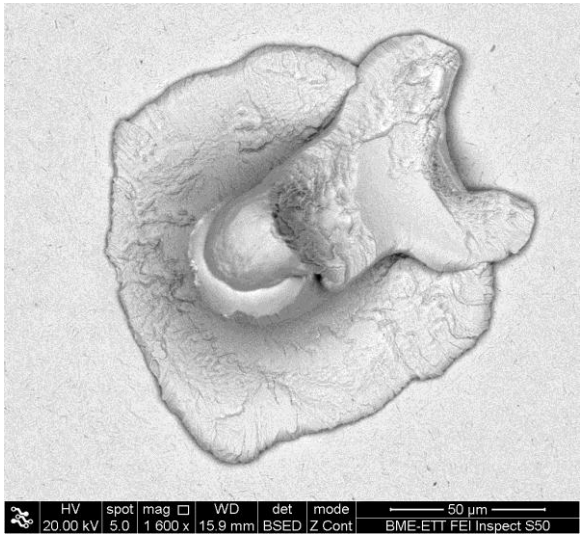
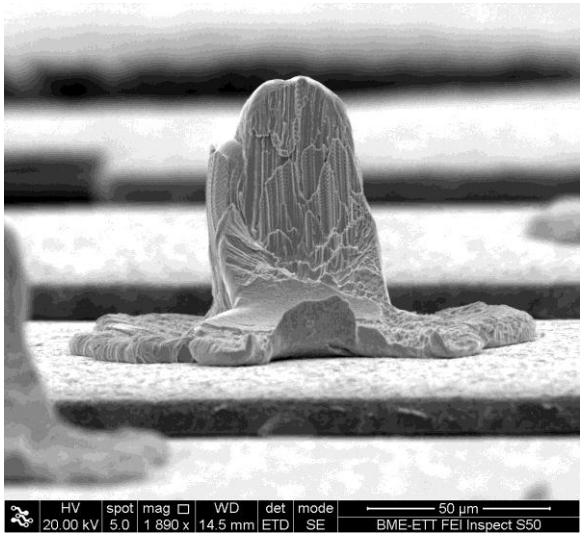
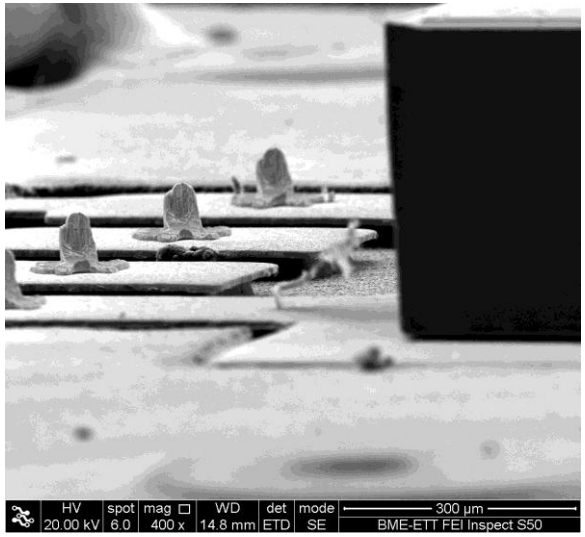
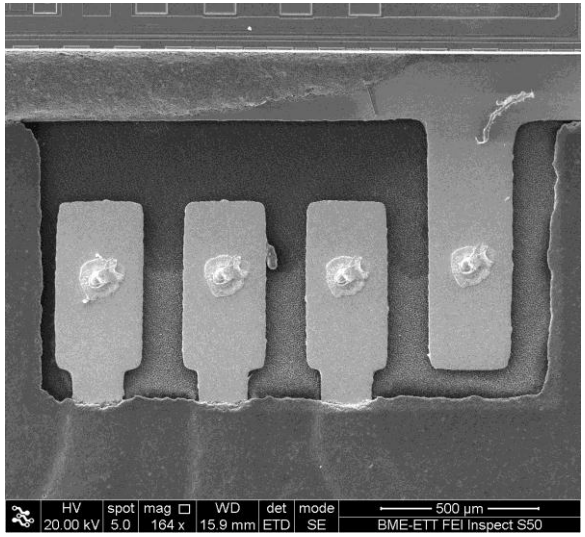
Stand-off-stitch or touch-down bonds



Stand-off-stitch (SoS) or touch-down bonds can be created by placing a bump on a pad prior to terminating the second bond on this pad either on the chip or on the substrate. In both cases a ball bond is created at first, then either the wedge (stitch) bond is made eccentrically onto the ball or the ball is planed by the same ball bonding capillary tool. Thus a high quality ball bond is attached to the pad, which protects the metallization and provides a monometallic interconnect for the crescent wedge bond.







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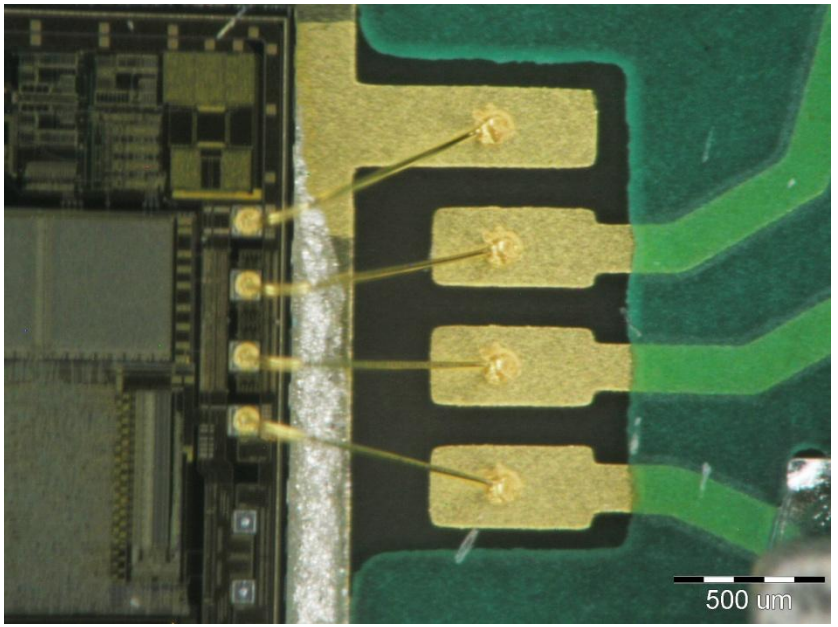
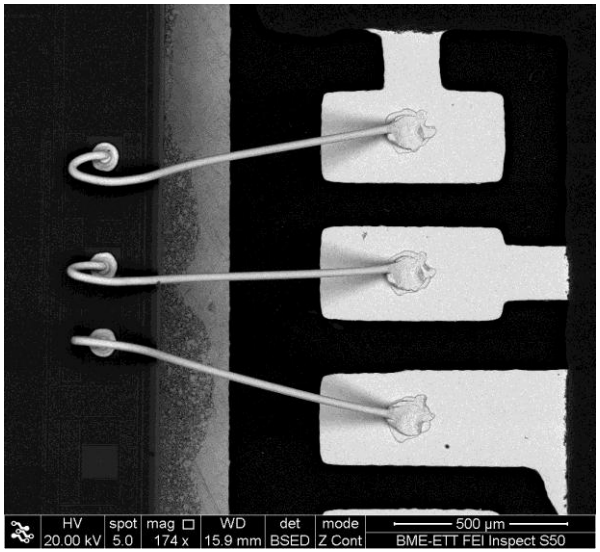
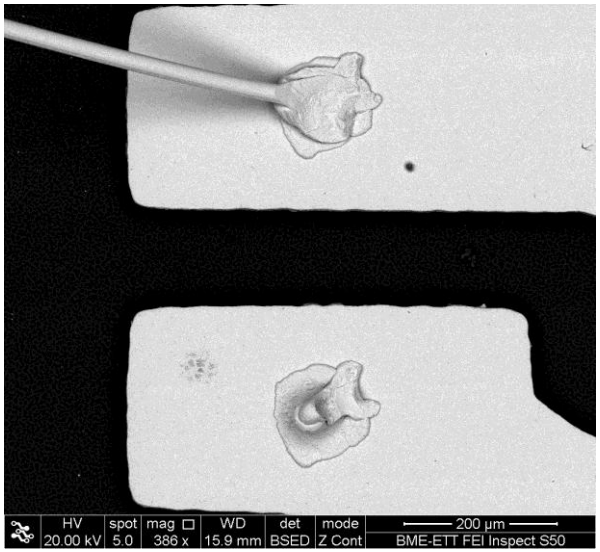
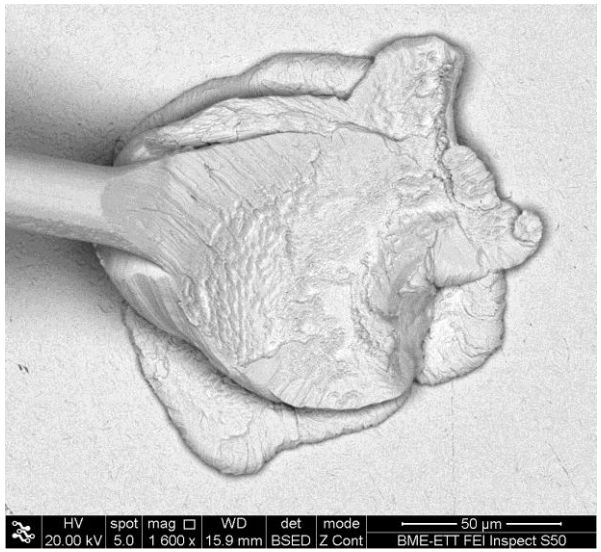
Touch-down bond with wedge bond crescent









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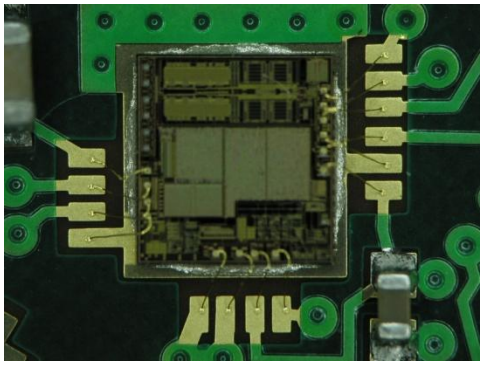
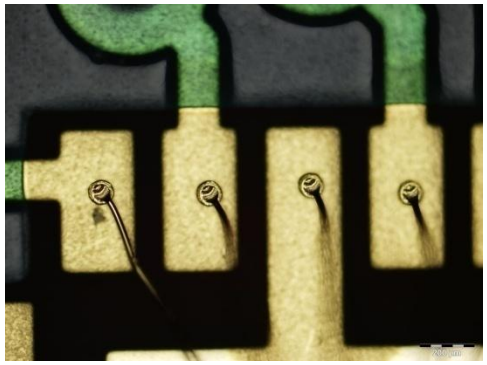
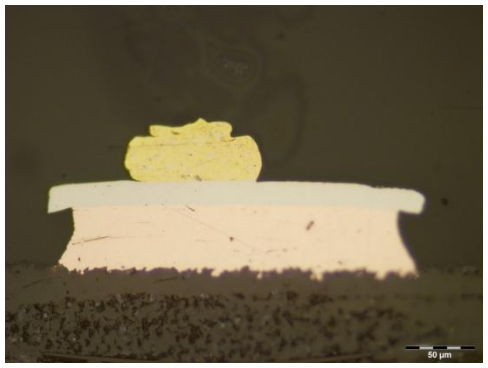
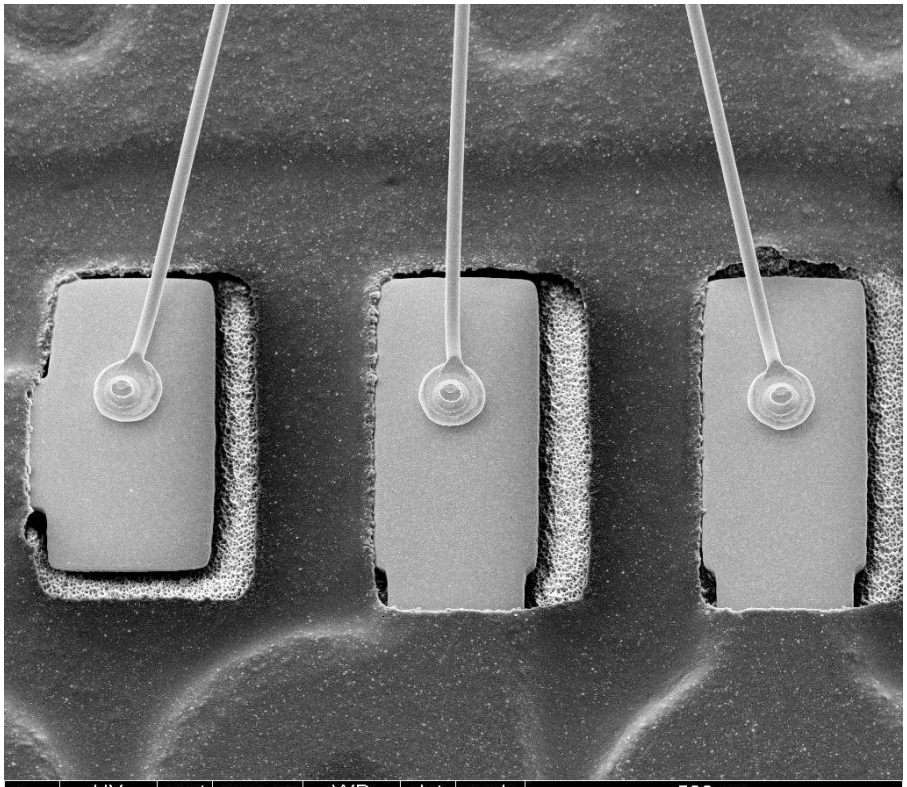
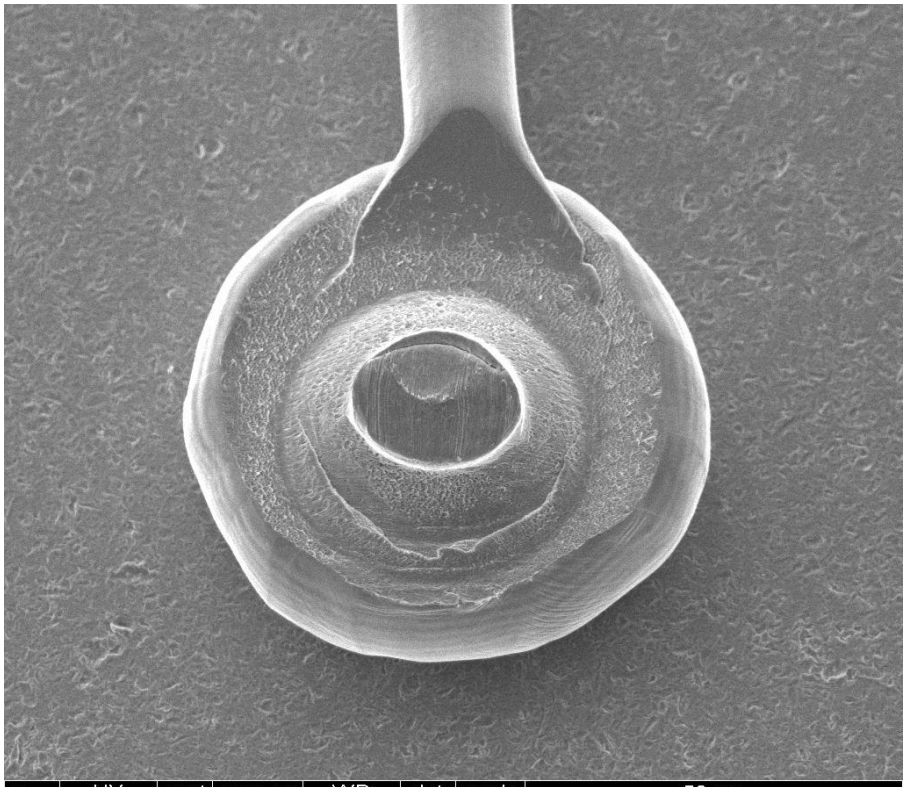
Wedge bond crescent on planed under-bump











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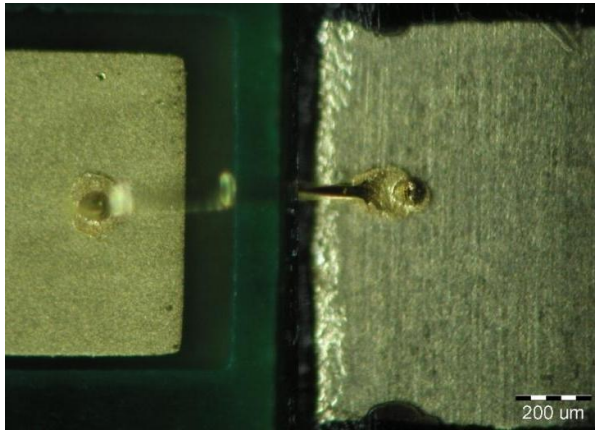
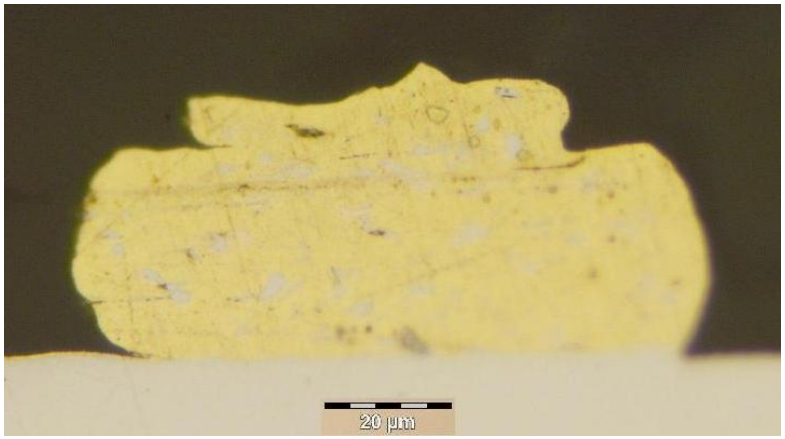
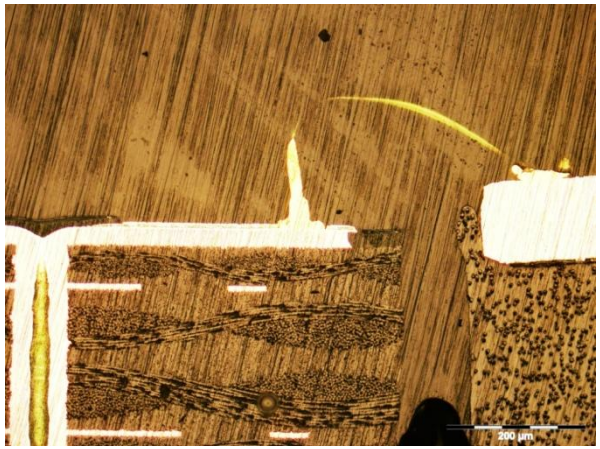
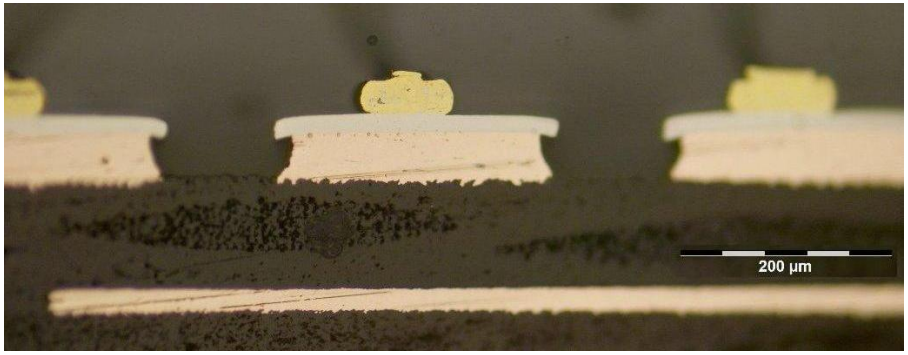
Terminals with wire bonds

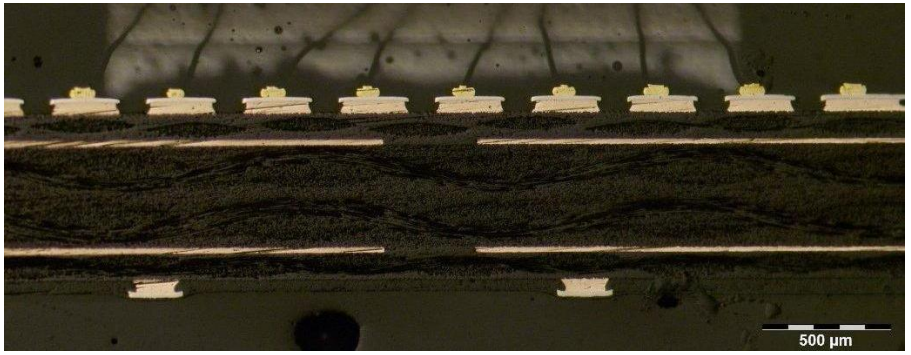
A top view and several cross-sections of terminals with thermosonic wire bonds are shown in the figures. They give us the possibility to study the shape of the terminals, the multilayer PCB structure, the under-etching at the PCB layers, the bonds and many more details.











PALOMAR TECHNOLOGIES

Data Sheet

8000 WIRE BONDER / BALL (STUD) BUMPER

semiconductor EDITORS' CHOICE

APA 2004 – WINNER

productronica 2005 – WINNER

High-Reliability I Precision I Repeatability

The 8000 Wire Bonder is a fully automatic, thermosonic, high-speed gold bumper, ball and wire bonder, capable of improving production yields and eliminating sources of variation in your processes.

This single process co-planar gold bumper is the only machine that can produce planarized gold bumps in one step.

The 8000 Wire Bonder is designed with a unique bond-head motion patented dual Z-axis with linear rotary motion, allowing for the formation of precise gold ball bumps by repeatable, smooth and tailless shearing of the wire. This provides the consistent formation of flat <20 micron high bumps, thus eliminating the need for a secondary coining process.

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Performance and Specifications

Cycle Times	0.125 sec/wire 0.077 sec/bump
Bond Type	Thermosonic ball and wire bonding, ball bumping
Wire Pitch	50 micron (using 20.0 micron wire)
Placement Accuracy	+/- 2.5 micron, 3 sigma
Deep Access Capillary	0.437 inch (11.10mm) - Standard 0.470 inch (11.94mm) - Standard Option 0.625 inch (15.88mm) - Standard Option 0.750 inch (19.05mm) - Optional
Bond Area	12 x 6 inch (304.8 mm x 152.4 mm)
Wire	Spool Size (diameter): 2.0 inch (50.8 mm) double-flanged spool
	Wire Diameter: 17.8 to 44.5 micron (0.7 to 2.0 mil)

Motion System	Resolution: 0.20 micron (X/Y axis)
	Repeatability: +/- 2.5 micron, 3 sigma
	Control System: Linear motor/encoder (X/Y), voice coil, encoder (Z linear / Z rotary)
	Z Axis Stroke: 0.78 inches (19.81mm)
Pattern Recognition	Vision System: Cognex Series 8000
	PR Theta: +/- 7 degrees from taught angle
	Focus Range (Depth of Focus): Programable focus across 0.600" (15.24mm) - focal lens floats on Z linear axis
	Capture Range: ~ 760-1300 micron (30-50 mils), magnification dependent

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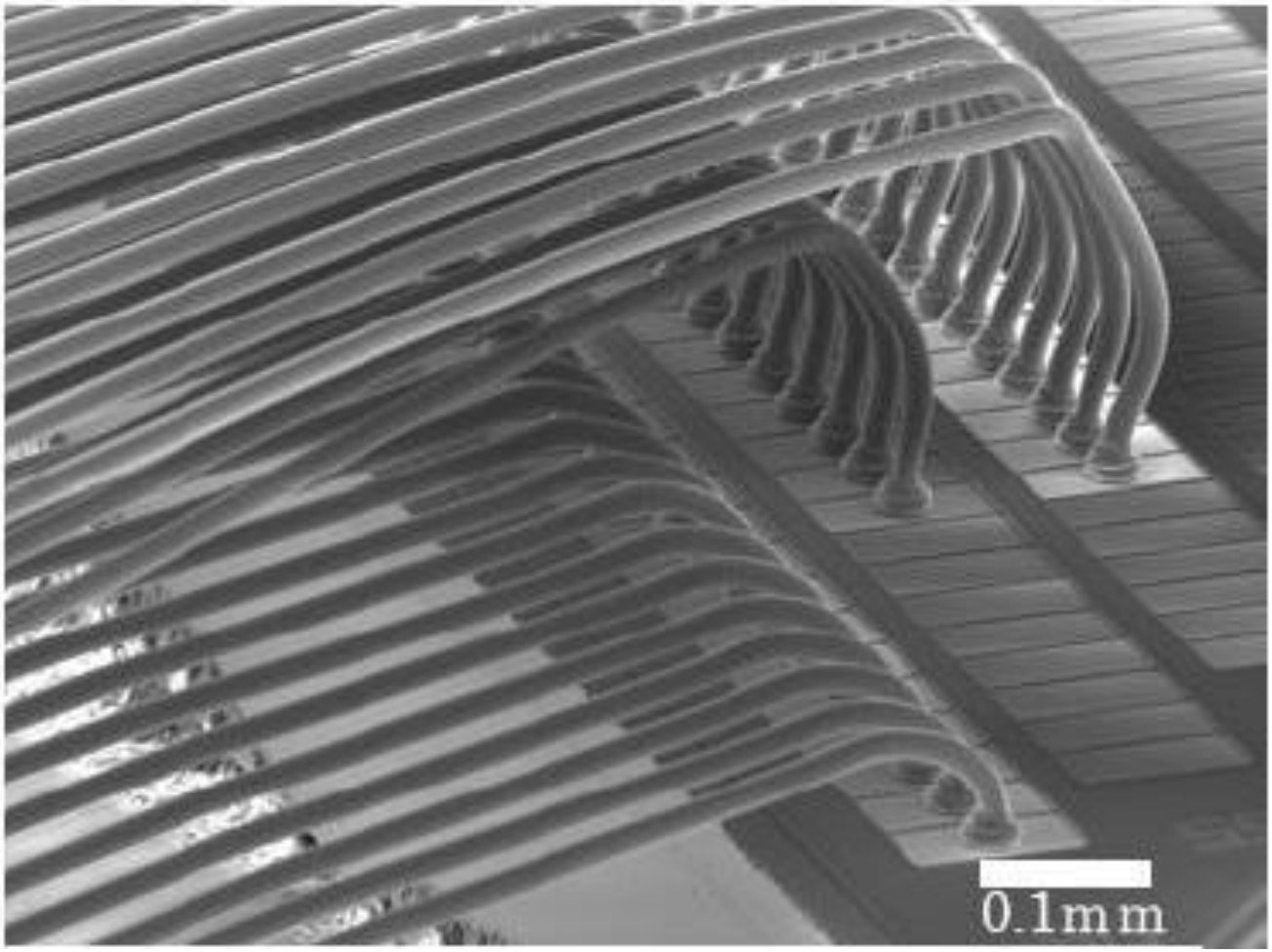
Thermosonic bonds for 3D packaging



Thank you for your attention!