# Journal of the Institute of Circuit Technology

## Contents



vol.3 no.2 1st April 2010

## 2010 Events

| | |
|---|---|
| *28th - 29th January* | *EIPC Winter Conference - Toulouse* |
| 3rd Febuary | 13.30 ICT Council Meeting<br>17.00 ICT AGM - followed by Evening Seminar, Norfolk Hotel, Arundel<br>The event is supported by Isola Group, CCI Eurolam, Ventec Europe and Taconic |
| *10th Febuary* | *09.30 IeMRC Packaging and Interconnection for Electronics and Sensors past,present and future.Tel:01223 899000 Riverside Offices, Granta Park, Cambridge.* |
| 2nd March | 17.00 ICT Evening Seminar, Devonport Hotel, Darlington |
| *9th -10th March* | *National Electronics Week SA*<br>*Sandton Convention Centre,Johannesburg* |
| 12th April - 15th April | **ICT Annual Foundation Course** , Loughborough University |
| *18th - 19th May* | *National Electronics Week UK*<br>*Hall 1 Birmingham NEC* |
| *7th-8th June* | *EIPC Conference, Nuremberg*<br>*www.sderhaag@eipc.org* |
| 15th June ( Please note DATE change) | **ICT 36th Annual Symposium**<br>Bracebridge Suite, National Motorcycle Museum at Solihull |
| *30th June* | *IMAPS-UK "Beyond Solder" - NPL*<br>*www.imaps.org.uk* |

## Editorial

**Martin Goosey**

As the recently elected new Chairman of the ICT, it gives me great pleasure to welcome you to the first issue of the Institute's Journal for 2010. Having worked in the UK PCB industry for many years and having also been involved with the ICT for a similar period, I have witnessed the major changes that have impacted our industry, often in a negative way. The number of producers has been dramatically reduced and the number of people employed by the sector is now a fraction of what it once was. Bearing this in mind, it might reasonably be expected that the ICT would also be experiencing a similar decline in membership and interest. In actual fact, the converse is true, with the Institute experiencing a sustained period of growth in membership numbers and also in the number of events that it offers its members. The Institute currently has 223 individual members and 12 group members. Most importantly, two thirds of our members have joined the ICT in the last 5 years; exactly the time when it might be thought that numbers would be declining. The ICT's membership is now drawn from well over 100 companies with more than 50% representing fabricators and suppliers. Companies supporting the industry are strongly represented and designers and design houses also provide a significant proportion of our overall membership. We are also fortunate in having members from academia, as well as from the assemblers and contract manufacturers. During 2010, we will be holding four evening seminars, two in the North and two in the South. The ICT will also be running its Annual Foundation Course at Loughborough University from the 12th to 15th April and holding its Annual Symposium at the National Motorcycle Museum in Solihull on the 15th June. *(please note DATE change)*

Recent new developments for the ICT have included our participation in a bid for European funding to support a multi-partner research project into new solderable finishes. If successful, the ICT will play an important role in leading the UK dissemination activities for the project. Another recent key development has been the publication of the Institute's own Technical Journal. In my view, this is not only a very important component of the overall package that the ICT is able to offer its members, but also a vehicle in which individual members can bring their work and activities to the attention of the wider membership. Our editor, Bruce Routledge, is always keen to hear from members and I encourage you to contact him if you have an article or paper that you would like to contribute.

I would welcome your feedback, comments and suggestions on how I, and the ICT Council, can work to enhance what the ICT offers you, the individual member, and the broader membership as a whole. I can be contacted at m.goosey@lboro.ac.uk and look forward to hearing from you. Finally, I hope you enjoy reading this issue of the ICT Journal and I hope to meet you at our forthcoming events throughout the year.

Martin Goosey, ICT Chairman

March 2010



## Membership

New members notified by the Membership Secretary

**Associate(A.Inst.C.T.)**

10160 Chetan Soni

**Member (M.Inst.C.T.)**

10157 Chris Goodall
10158 Dave Morrison
10159 Richard Connolly

**Fellow (F.Inst.C.T.)**

9902 Andrew Hall (rejoined)

## Corrections and Clarifications

*It is the policy of the Journal to correct errors in its next issue.*
*Please send corrections to : -*
*E-mail : bruce.rout@tiscali.co.uk*

*The Journal of the Institute of Circuit Technology is edited by Bruce Routledge on behalf of the*
***Institute of Circuit Technology.***
*30 New Road, Penn. High Wycombe, Buckinghamshire, HP10 8DL*
*E-mail : bruce.rout@tiscali.co.uk*

## Brief Report of the ICT AGM held Wednesday 3rd Febuary 2010 at the Norfolk Hotel, Arundel

Martin Goosey was deputising for the retiring chairman, Steve Payne.

The Treasurer's report confirmed that the Institute was financially sound.

The Institute has been registered as a Limited Company to enable us to partake in European funding and dissemination initiatives.

We continue to offer training and development courses and technical seminars for our members.

Sincere thanks were sent to our retiring Chairman, Steve Payne for his most sucessful term of office.

The Council elected :-

Martin Goosey - Chairman
Andy Cobley - Vice Chairman.

*(Copies of the minutes and reports are available from the Secretary, at :- bcsbasingstoke@btinternet.com)*

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## Institute of Circuit Technology Evening Seminar Wednesday 3rd Febuary 2010

Bill Wilkie welcomed a large audience of 55 delegates to the evening technical session themed on "High Performance Laminates".

*Special thanks were acknowledged to the four sponsor companies of the evening:* ***Taconic, Isola, Ventec Europe and CCI Eurolam.***

The first presentation **"Material for Flexible Printed Circuits"** was from **Dominique Garmy, Senior Accounts Manager, High Performance Laminates, DuPont.**

Dominique has over 30 years experience with flexible materials and outlined the history and development of flexible laminates. He explained the choice of materials today and the development of new materials for the future. He explained how to choose dielectrics, adhesives and copper styles to suit the technology demands of the application. Water absorption is still the key cause of delamination and baking cycles up to 24 hours may be required in some instances. Future materials will give the designer the choice of very thin or thick copper as well as alternative metals such as aluminium, constantan and other resistive foils. A polyimide product is now available with a copper or aluminium heat sink incorporated which is mainly intended for LED applications. High speed controlled impedance flex material. Black Kapton and very thin dielectrics down to 12 microns are now available.

The second presentation was by **Jim Francey of Taconic**. Jim is **Technical Service Manager, Advanced Dielectric Division.**

The development of point to point high speed wireless applications enabling gigabyte transmission rates requires that signal degradation in conductors must be reduced as far as possible. PCB constructs are preferred to ceramic due to the very much lower tooling costs. The engineering aspects are demanding for the PCB manufacturer. The use of Rolled and Annealed copper is preferred with a resulting trade off of lower peel strengths. Surface finishes have to be considered to minimise conductor loss. Silver is a preferred finish due to the excellent conductivity properties. Depth milling is used to mount "Monolithic Microwave Integrated Circuits" into cavities on the surface of the PCB to enabling shorter wire bond lengths. Printed filters require best in class imaging and etching capabilities. Very precise milling of the PCB material is also required to enable advanced connectors to be mounted. Dimensional stability of materials must be optimised to ensure layer to layer registration is near perfect. Passive inter-modulation from adjacent signals on the PCB must be minimised. Contaminants on the edge of pcb tracks can cause increased inter-modulation. High frequency PCB's will require the use of laser cutting for complex features and connect interfaces.

The next two presentations were from **Alun Morgan, Director of OEM Marketing, Europe for the Isola Group and MD of Isola UK.**

Alun explained the driving forces for the development of PCB base materials. Key factors are thermal stability, signal integrity and cost performance. With the advent of Lead free soldering the thermal reliability of the base material is now of prime importance. The ability to withstand the increased temperatures, the enhanced demands of thermal cycling and the elimination of conductive anodic filamentation (CAF) are all critical for today's laminates. Delamination and decomposition properties have been improved by the use of phenolic and novel curing agents. Increased Tg values and inorganic fillers have reduced z-axis expansion during the thermal cycling phases of assembly, rework and during the PCB life cycle. CAF failures are typically propagated at the glass to resin interface. Modification of the glass fabric to incorporate a more evenly distributed glass weave has improved the ability of the resin to wet and impregnate the glass bundles. Circuit design has also to be considered where CAF may develop. For example critical gaps may be staggered off the x and y axes in order to improve performance. Signal integrity was then discussed. Signal frequencies are continually increasing. The increased data rates, higher computing power and the need to reduce energy loss in the PCB are all key factors. The choice of dielectric properties and the influence of different styles of copper foil need to be fully understood by designers

Alun then gave a brief overview of Halogen Free Laminates. Halogen free means "free of halogenated flame retardants". Asia is primarily the driving force for the use of these materials. Bromine compounds are still by far the most widely used flame retardants worldwide. As there is no legislation in place to limit the use of the reactive bromine based fire retardant, TBBA, the adoption of bromine free laminates is largely marketing driven.

In 2010 Europe will follow the lead from the USA and Japan in enhancing the requirement of television casings to once again have a degree of flame retardancy. Despite the lack of supporting scientific evidence there are still lobbyists who continue to put pressure on the use of halogen fire retardants so the research and development of alternative materials is important.

Bill Wilkie closed the meeting by reminding delegates of the forthcoming ICT Foundation Course to be held at Loughborough University from the 12th to 18th April, and the ICT Annual Symposium to be held at the National Motorcycle Museum on 15th June. *(please NOTE change of date)*

**Richard Wood-Roe**
ICT Council

Alun Morgan | Jim Francey | Dominique Garmy

*The slides shown during the presentations can be viewed as follows :-*

ICTA DuPont Flexibles.pdf
ICTA DuPont HighSpeedFlex.pdf
ICTA DuPont LED Materials.pdf
ICTA DuPontEmbedded Resistor.pdf
ICTAJimFrancey.pdf
ICTAAlunMorgan1.pdf
ICTAAlunMorgan2.pdf

# Advancements in Laser Direct Imaging for Solder Mask Applications

**Dror Shklarski, M.Sc.**
Marketing Manager - PCB Division,
Orbotech Ltd.

With the relentless pressure on PCB manufacturers to keep pace with the accelerating rate of technology advancement, the utilization of effective production tools that provide highest quality, cost-effective results in critical process steps, is an essential part of a successful production strategy.

Solder mask is an area that can greatly benefit from latest digital techniques. In particular, is the opportunity to leverage the proven capabilities of Laser Direct Imaging (LDI) for solder mask applications.

The exceptional performance of LDI for highly complex and intricate imaging make it well suited for solder masks where highest registration accuracy and top image quality on increasingly smaller feature sizes and improved side wall geometry (higher aspect ratio) are demanded. Fig.1 illustrates the technology development of PCB patterning that implies to higher resolution demands from the solder mask layer.

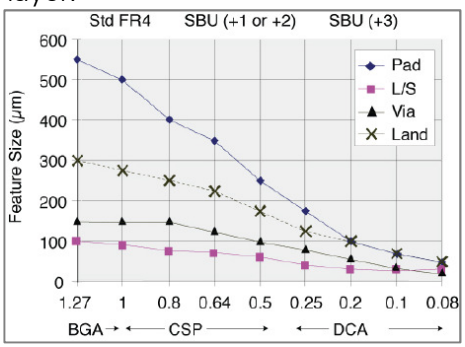



*Fig. 1: As pitch drops down, solder mask resolution approaches that of patterning (Source: IPC International Technology Roadmap for Electronic Interconnections 2008-2009).*

The forecast of the demand from the rigid PCBs of solder mask are described in Table 1.

**Table E1-32 – Solder Mask Attributes**

| ATTRIBUTE | CURRENT 2008 – 2009 | | NEAR TERM 2010 - 2011 | | MID TERM 2012 -2013 | | LONG TERM 2014 - 2018 | |
|---|---|---|---|---|---|---|---|---|
| | RCG | SoA | RCG | SoA | RCG | SoA | RCG | SoA |
| Dam size (µm) | 100 | 40 | 85 | 35 | 75 | 30 | 67 | 25 |
| Registration (µm) | 60 | 35 | 50 | 30 | 40 | 25 | 35 | 22 |
| Side wall definition (ratio) | 4:1 | 5:1 | 4:1 | 6:1 | 5:1 | 8:1 | 5:1 | 9:1 |

** RCG: Revenue Center of Gravity (main source of revenue)*
*** SoA: State of the Art (<5% WW production)*

*Table 1: Solder mask requirements (Source: IPC International Technology Roadmap for Electronic Interconnections).*

LDI has now been proven by tens of PCB manufacturers as the ideal solution for digital imaging of solder masks. With LDI able to deliver the same leading capabilities in registration, accuracy, image quality, depth of field and resolution for solder mask as it does for patterning resists, PCB manufacturers can achieve much better results in this process step than possible with traditional exposure methods.

*Figure 2: Laser Direct Imaging system for solder mask applications (Courtesy of Orbotech).*

## Highest Registration Accuracy

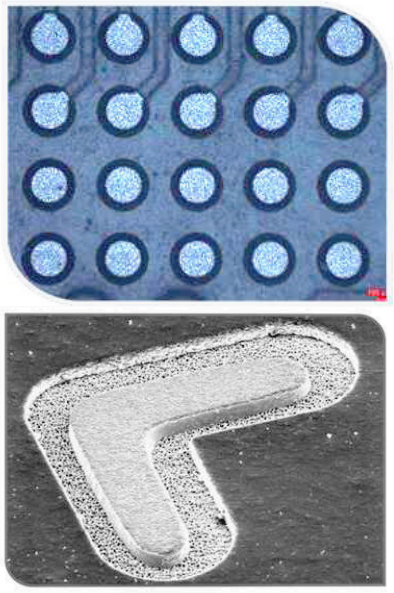
While registration capabilities that are able to handle even the tightest annual rings with positioning accuracy of 0.5mil are one step in meeting panel accuracy requirements, each panel is distorted differently. To be most effective, specialized imaging/scaling techniques are also needed to best meet total accuracy demand. Therefore, not less important is the need for a range of dynamic imaging modes as:

(1) Auto-scaling enables each individual panel to be scaled according to its distortion;

(2) Fixed scaling allows all panels per batch to use the same scaling;

(3) Partial printing that simulates the shutter-exposure scheme, by imaging N areas (step & repeat).

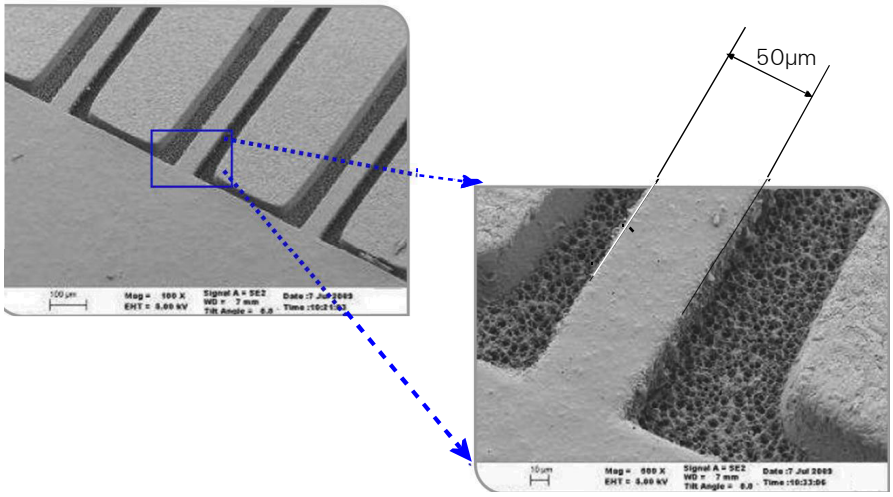
A high depth-of-focus of ±300µm overcomes the most challenging surface topography changes and/or any distorted PCB topography.



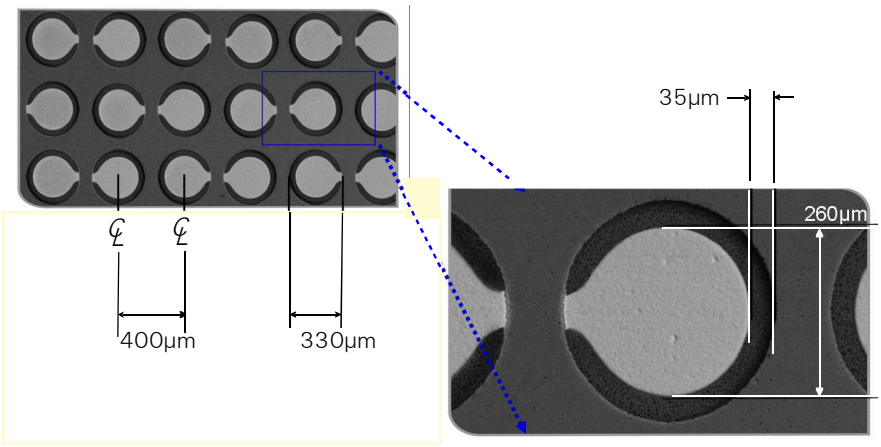
*Example 1: LDI's tight registration accuracy (Source: Orbotech Paragon™-SM 20 LDI System).*

## High Resolution Capabilities

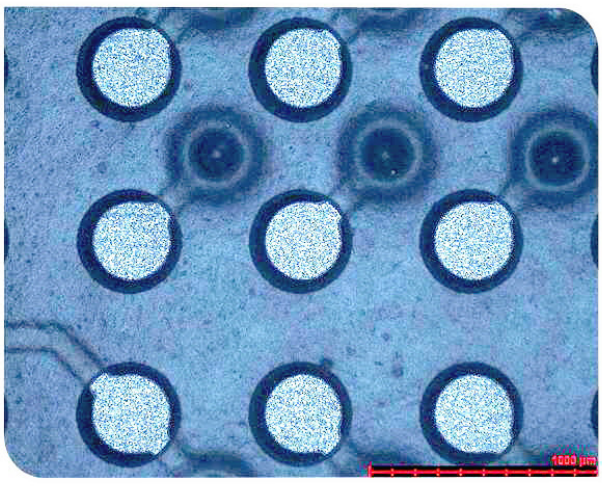
For the requirements of solder mask processing, LDI's high resolution capabilities ensure superior results that enable consistent, top quality imaging of even the most complex designs (as illustrated in examples 2,3 & 4).




*Example 2: LDI Results on Small Solder Dams (Source: Orbotech Paragon™-SM 20 LDI System).*




*Example 3: LDI Results on Tight Annual Rings (Source: Orbotech Paragon™-SM 20 LDI System).*



*Example 4: LDI Results on Small Solder Mask Openings (Source: Orbotech Paragon™-SM 20 LDI System).*

## Maskless Imaging

LDI reduces the complexity of the solder mask imaging operation by removing the need for the phototooling and film preparation processes, saving time and costs associated with labor, material, utilities (e.g.: electricity) and more. Image quality is also improved through the elimination of phototool contamination and damage.

## Efficient, Damage-Free Panel Handling

Available as an automated solution, today's most advanced LDI systems are available in standalone or in-line configurations suited to imaging solder mask panels with damage-free handling. They also feature specially-designed vacuum plates and dedicated vacuum controls to further ensure damage-free processing.

## Ease-of-Use

LDI can be smoothly and quickly integrated into the PCB production environment. With a user-friendly and intuitive graphic user interface, the system can provide simple operation and seamless connectivity to CAM to ensure fast and easy set-up. In addition, advanced LDI system can recognize a wide range of different target type regardless of solder resist color.

High accuracy solder mask exposure with increased throughput for HDI and RF-Flex applications is now possible with latest advancements in LDI technology. Utilizing LDI as a key production tool for solder mask imaging ensures the highest yields while satisfying even the tightest registration accuracy requirements with lower imaging costs per panel.

**Dror Shklarski, M.Sc.**
Marketing Manager -
PCB Division, Orbotech Ltd.

# Packaging and Interconnection for Electronics and Sensors – Past, Present and Future

**A seminar to mark the retirement of**
**David Pedder** - 10 February 2010 TWI, Granta Park, Abington, Cambridge

**Dr David Pedder**

On 10 February 2010, TWI in Abington, Cambridge, hosted a seminar on

**Packaging and Interconnection For Electronics and Sensors Past,Present and Future**

This event had been organised to mark the retirement of

**Dr David Pedder**,

who had been a key figure in the electronics industry since 1971.
The first presentation, entitled **'Packaging of pyroelectric arrays for people counting and thermal imaging applications'**, was given by **Jon Hall of Irisys**.
Detectors using pyroelectric arrays were finding widespread use for thermal sensing to detect and track people. The devices used in these applications operated in the 8 to 14 micron range and were typically based on a 16 by 16 array of sensor elements. The pyroelectric ceramic detector could operate at up to 150C and it was flip chipped onto an ASIC using isotropic conductive adhesive. The assembly was then packaged in a low cost 28 pin DIL package based on FR4 with soldered leads and a silicon window which was epoxy sealed. Although this was not a fully hermetic package tested devices still worked after one year's exposure at 65C and 85% RH. The alignment process using a semi-automatic bonder was described and this was capable of an accuracy of 12 microns. A camera was demonstrated that combined a visible and a thermal image; it could be used to spot problems in electrical and mechanical equipment.

The second paper was given by **Peter Robinson of CSR (Cambridge Silicon Radio)** who began by describing the wafer level chip scale package (WLCSP), the package of choice for handset applications. The structure of the WLCSP was detailed and these used SnAgCu solder balls. There was an ultrathin version with thinned silicon which was only ~300 microns in total thickness. Examples of modules incorporating these devices were shown, including one where the module had been buried in a multilayer PCB. Typical problems encountered at this level included electrical and magnetic coupling between ICs and the packages and modelling was being undertaken in order to minimise and, if possible, eliminate these effects. There were also thermal interactions, particularly as ICs became smaller and feature integration increased. Examples of thermal interactions between the chip and package were shown and these illustrated localised heating. Peter concluded by showing results illustrating how a newly developed assembly process gave enhanced drop test performance. Current work at CSR was focussing on the use low K dielectrics, copper wire bonding and WLCSP processing and reliability.

**David Selviah of University College, London,** then gave a presentation entitled **'Polymer wave guide optical interconnect manufacturing**' in which he described a large multipartner project that had been funded by the Innovative Electronics Manufacturing Research Centre (IeMRC). David began by comparing copper tracks with optical waveguides for high bit rate interconnections. Copper tracks suffered from EMI, crosstalk, loss and required impedance control in order to minimise back reflection. They also required more expensive board materials. Optical waveguides offered low loss, low crosstalk, low power consumption and reduced cost, but they could not transmit electrical power. The focus of the project had been on multimode waveguides operating at 10 Gb/s that were incorporated onto a 19inch PCB. The project included 8 industrial partners and 3 universities. Waveguide materials had been supplied by Dow Corning and Excellis and assistance with the PCB design rules and tools had been provided by Cadence. End users who were interested in implementing the technology were Renishaw, Xyratex and BAe Systems. A demonstrator device was described and this had been built at Stevenage Circuits with the waveguides being added by IBM in Zurich.

The final presentation in the morning session was given by **Eric Beyne of IMEC** and he spoke on **'MEMS packaging and 3D interconnection'.**
Eric began by highlighting that MEMS packaging was particularly important because of the fragile moving parts that they typically contained. He then discussed work linked to an EU funded project called MEMSPACK which was running until May 2011. Eric described the basic process for making MEMS and sensor devices. Encapsulation was typically carried out at the wafer level and needed to be hermetic. Through silicon vias could provide an important route for providing the escape I/Os for these devices and could be followed by flip chip bumping. Sealing methods were also described and these included the use of polymer seals, although they didn't provide a true hermetic seal. Control of the process parameters was critical if the sealing process was to be successful, cracking was to be avoided and the joints were to be leak tight. Eric then described a novel technique for metal to metal bonding which used a high precision diamond bit to cut bumps on the fly. This technique enabled the copper to copper bonding temperature to be reduced from >300C to ~225C. The technique could also be used with copper and tin. The presentation concluded with a description of the through silicon via process.

The first presentation of the afternoon was given by **Martin Goosey, Industrial Director of the Innovative Electronics Manufacturing Research Centre (IeMRC).** The presentation was entitled **'Advanced PCB Interconnection Technology – Materials Challenges'** and, after an introduction to the work of the IeMRC, Martin discussed some of the materials challenges related to the manufacture of high performance circuit boards. Martin began by describing how PCBs continued to be the interconnection medium for most electronics and highlighted how their materials and manufacturing processes had evolved to meet the evolving performance demands of end users. He then went on to discuss three examples of where improved performance was required from PCB substrates and how, by changing the basic chemistry, it was possible to offer the required enhancements.
The examples cited were the need for higher thermal stability, the move to halogen-free and the requirement for better performance in higher frequency applications. Martin described how moving away from the basic chemistry of

FR4 with its dicyandiamide curing system to the use of novolac resin systems could give better thermal stability. He also highlighted how changes in the basic chemistry of the resin systems of PCB substrates could also lead to a need to adjust the chemical processing stages such as desmear. Other ways of offering these enhancements were also described and it was noted that higher performance substrates were often more expensive than their conventional standard counterparts.

**Cian O'Mathuna of the Tyndall Institute** then gave a presentation on '**Magnetics on silicon – an enabling technology platform for power supply on chip'** Cian began by giving an introduction to the Tyndall Institute which now employed over 400 people. One key area of activity was on autonomous sensors and their interfaces to the outside physical world. These often needed to be self powered, networked, and with a wireless communications capability in order that they could be used in 'deploy and forget' applications. Ideally, they should also be very low cost and occupy little space. Current work was focussing on applications in the energy, environmental and health sectors. An example was shown of a PCB embedded magnetic flux gate sensor. The vision for a power supply on a chip was described and the likely power requirements described. An example was also detailed in which the accompanying leadframe could provide the function of an inductor. A bottleneck was the integration of passives onto the silicon and the key to achieving this was having a silicon compatible device footprint. NXP were cited as having developed trench capacitors on silicon. Micro-fabricated magnetics had been put on silicon via electroplated windings and this was said to be a low cost process.

The third presentation of the afternoon session was entitled **'Everything including the chip: DfM challenges and advanced packaging technologies**' and was given by **Jonathan Edwards of ST-Ericsson.** Jonathan began by describing how the level of functionality and miniaturisation required by today's mobile wireless devices required a level of integration that could not be achieved by Moore's Law scaling alone. Advanced packaging solutions were needed to increase the effective device packaging density. He then went on to show how the packaging roadmap had evolved over the past decade in order to meet the needs of mobile wireless applications, moving from the simple single die wire bonded BGA to today's complex variety of package solutions, which included flip chip wafer level chip scale packages, multi-die modules, chip stacking and multichip system in package on wafer. He then presented details of the embedded wafer level ball grid array technology developed jointly by ST, Infineon and STATSChipPAC.

There followed a paper from **Zarlink** that was given jointly by **Piers Tremlett and Henry Higgins.** The presentation was called **'Medical Electronics and Miniaturisation:** A Fantastic Voyage' and it began with an historic look at some of the crude techniques that had been used in the past for examining the body, up to the employment of the present day endoscope. The basic structure of a camera pill was then outlined and this was described as effectively being a miniature submarine that moved by electro-stimulation of the bowel or oesophageal muscles. Examples of prototypes of these capsules were shown, along with the electronics they incorporated. The electronics employed bare die chip and wire, flip chip, die stacking, integrated passives and a range of other advanced technologies. These devices enabled pictures to be taken of areas that had never before been seen, with little inconvenience to the patient. The presentation concluded with a review of some of the related projects in which Zarlink were involved and these included NEMO, SIMM and TIPS.

The last paper of the day was given by **David Pedder** and was entitled '**Passive Integration and System in Package: past present and future'.** David began by discussing some of the projects he had worked on over the last four decades, beginning with his research in the 1970s on internally oxidised alloy powders and thenmoving on to his early involvement in surface mount technology during the 1980s. This included thermal cycling reliability testing of ceramic packages on FR4, FR4-Cu-Invar and other materials. He also described his 1980s work on uncooled IR sensors, which involved flip chip attachment of the pyroelectric sensor arrays onto silicon. At this time he also worked on silicon MCM and flip chip GaAs MMICs. During the 1990s there was work on MCMs for RF applications and many other interconnect and packaging related projects. For the first decade of the new century David chose, as examples of his work, the ADEPT project and the EPPIC Faraday Partnership which had the objective of 'Consolidating the Packaging and Interconnection Capabilities of the Electronics and Photonics Sector'. He then went on to discuss system in package (SiP) and the various categories and architectures There was also a discussion of the capabilities of the different types of integrated passives. Forthis decade,David covered precision passives for micro-module (PPM2) applications and highlighted SIC based SiP technology, along with the further development of high density interconnects, active and passive substrates and a number of example demonstrators and applications.

The technical part of the seminar was brought to a close by Roger Wise of TWI, and the event concluded with a champagne reception.

**Martin Goosey**
February 2010

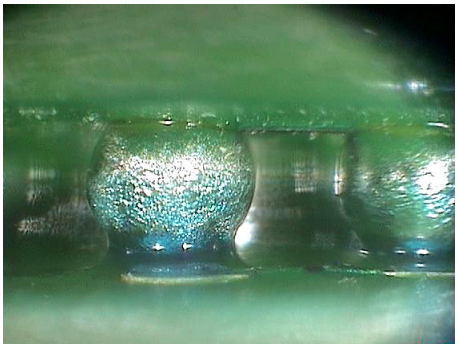
L to R; Roger Wise, TWI; Jon Hall, Irisys; Jonathan Edwards, ST-Ericsson; Cian O'Mathuna, Tyndall Institute; Piers Tremlett, Zarlink; David Pedder; Peter Robinson, CSR; Henry Higgins, Zarlink; Eric Beyne, IMEC; Martin Goosey, leMRC, Loughborough University.

# Measuring Package On Package – Possible Procedure, Comments Welcome

## Bob Willis

Dave Bernard (Dage) and I have been considering a possible method of measuring the standoff height of PoP devices after soldering and the possible detection of any variation in the assembly process. Obviously you still use existing optical criteria and with possible enhancements planned in IPC 610, the document may become more useful to staff faced with inspection of area array devices. Alternatively the PoP inspection posters are available from the SMTA, IPC, SMART Group and www.solderingstandards.com

Package on Package assembly features paste only assembly or a combination of solder paste at board level and dip flux on the top row of ball terminations. The following two images show packages assembled ready for soldering.



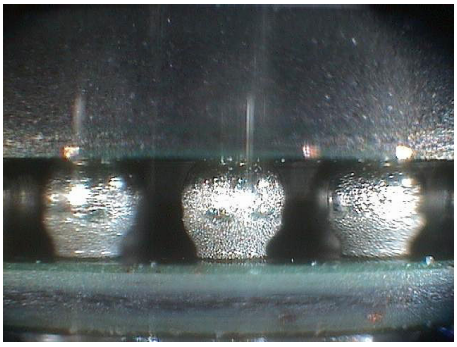


*Fig 1 & 2 PoP assembly with dip flux which is blue in colour and a dip paste with a type 5 solder paste*

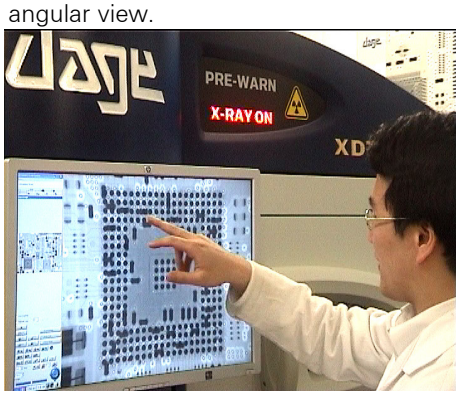
The following is a draft procedure used during our hands on PoP Workshops run in Europe to gain data on the range of stand off heights of packages to compare with other process parameters. Details on these workshops are available at:-

www.ASKbobwillis.com/PoPworkshops.pdf

Measuring the stand off height for PoP assemblies can be beneficial as a process control tool in manufacture or at goods receipt. This can be conducted manually, using a high resolution x-ray system or with Automatic Optical Inspection AOI system fitted with laser height measurement. This is a technique we have used before on QFN/LGA assembly inspection, in this case to compare the void formation and the correlation with stand off height.

Manually it is possible to measure the four corners of the device, measuring the top of the stack to the base of the board and comparing the results with existing measurements from other satisfactory samples. In the case of AOI system with laser capability the laser is used to measure the difference in height. This can also be conducted at different locations along the edges of the device for possible warping, a known problem with PoP technology. The technique can be used for most PoP devices after first level package assembly, circuit board assembly or when a combination of no-flow underfill and reflow are used during manufacture.

Using high resolution, x-ray measurements can be taken in the four corners, the following procedure provides a guide to this method. Place the PoP assembly in the x-ray system, making sure the assembly is held horizontal to the support tray. Make sure that the system is set to take a vertical view on the corner section of the device using the highest magnification and three or four balls on the top layer in the field of view. The system must be fixed vertically with no angular view.



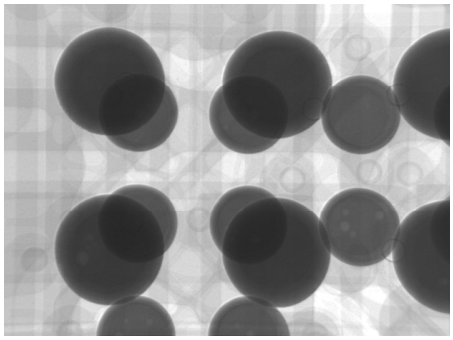



*Fig 3 & 4 Identification of the area of interest during x-ray inspection of device, the image shows the corner of a PoP device during high resolution x-ray inspection with four groups of terminations from level one and two in the field of view*

Take a measurement from the edge of the ball termination on the top level to the opposite side of the termination on the lower package balls. Repeat this measurement on the four groups of terminations in the field of view and record the measurements. Alternatively it may also be possible to measure from the edge of the pad to the opposite side of the lower pad interface. There can be variations in the ball size particularly when via in pad technology is used with more voiding or loss of the solder to the via.

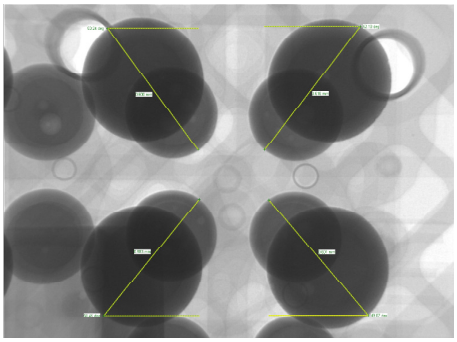


*Fig 5 Shows the corner of a PoP device with the grouping of terminations with measurements between the top and lower package*

Without changing magnification or the viewing angle move the position of the board to each of the four corners and repeat the measurements. It is important that the board assembly remains flat during this examination particularly if measurements are to be taken on multiple devices on the same assembly.

Selecting a specific ball group in the centre along each edge of the device a similar measurement can be taken to look at warping along the side of these devices. In this case one ball is taken on both layers for comparison on each side

This technique does not rule out full x-ray inspection of the solder joints but provides another process control method which could be used to gather data from a process and compare it with an existing database of successful results or to compare failures with a historically stable process

Please send you comments suggestions on this draft procedure to bob@bobwillis.co.uk

Bob Willis is a process engineer working in the electronics industry, providing training, consultancy and process/product failure analysis. Bob offers on site workshops on conventional and lead-free manufacture. Bob will be running three new US workshops at APEX 2010 covering PoP, Conformal Coating and Counterfeit Components. Bob is happy to offer 10% off any of his upcoming workshop to ICT Members at http://www.askbobwillis.com/faworkshops.pdf

# Bernard Coles

## A Scottish born P C Engineer known throughout the Industry at the peak of its growth.

Bernard Coles, who has died aged 67 after a long fight against cancer, was a very well known figure in numerous companies when the UK Printed Circuit Industry reached its highest productivity.

He was born in Campbeltown, Scotland while his father was in the services. The family moved south to Bathford after the war, when Coles was 4 years old, where he attended the local school and later a boarding school in Bridgewater.

Bernard played rugby for Bath for a couple of seasons back in the days when you played for the love of it.

He worked as an apprentice at Westinghouse in Chippenham - as did about every other draughtsman and toolmaker in Chippenham and the surrounding area - , before going to Kode the owners of KAM Circuits in their early years around 1974.

The next important move was to Irlandus where he ran the plant they set up in Donegal, followed by a period with Cityprint and later at Tectonic in Wokingham, Berkshire.

Then came Forward Circuits where he was part of the team that took the Company to the stock market.

In the late 80's Bernard retired from the Forward Group and after playing a lot of golf, busied himself again in the PC Industry with Astra Circuits and later partnered Pete Jackson at Instagraphic. His final thrust was in 1995 when he joined Maurice Hubert as a partner in Elektrotech and spent his later years in the business working with Maurice from a chicken farm in Wiltshire.

His funeral was attended by over 300 people from various sectors of Bernard's life which indicated how much he was respected by all who knew him.

Bernard is survived by Stephanie, his children Helen and Robert, and his four grandchildren.

**Maurice Hubert**

*Bernard Coles , PC Engineer, born 1943, died March 2010*

Back row. Maurice Hubert, Eric Duprex, Rob Shore, Pete Starkey
Front row. Alun Morgan, Robert Morgan Bernard Coles.

## Group Members of The Institute of Circuit Technology March 2010

| *Organisation* | *Address* | *Communication* |
|---|---|---|
| **Anglia Circuits Ltd.** | Burrel Road, St.Ives, Huntingdon PE27 3LB | 01480 467 770 www.angliacircuits.com |
| **Artetch Circuits Ltd.** | Riverside Ind. Est. ,Littlehampton BN17 5DF | 01903 725 365 www.artetch.co.uk |
| **Atotech UK Ltd.** | William Street, West Bromwich. B70 0BE | 01210 067 777 www.atotech.de |
| **CCE Europe** | Wharton Ind. Est., Nat Lane, Winsford | 01606 861 155 www.ccee.co.uk |
| **Electra Polymers Ltd.** | Roughway Mill, Dunks Green, Tonbridge TN11 9SG | 01732 811 118 www.electrapolymers.com |
| **Faraday Printed Circuits Ltd** | 15-19 Faraday Close, Pattinson North Ind. Est., Washington. NE38 8QJ | 01914 153 350 www.faraday-circuits.co.uk |
| **Flex-Ability Ltd** | Prospect Way, Park View Ind. Est., Hartlepool TS25 1UD | 01429 860 233 www.flex-ability.co.uk |
| **Graphic plc** | Down End, Lords Meadow Ind. Est., Crediton EX17 1HN | 01363 774 874 www.graphic.plc.uk |
| **Invotec Group Ltd** | Hedging Lane, Dosthill , Tamworth B77 5HH | 01827 263 000 www.invotecgroup.com |
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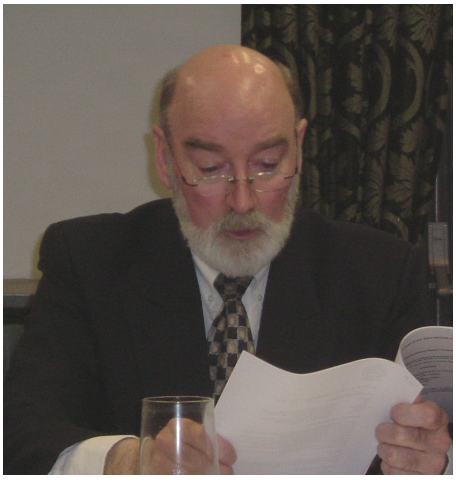

### The Membership Secretary's notes March 2010

We left the last journal entry, looking forward to our Annual AGM and evening Seminar at the Norfolk Arms in Arundel and it did not disappoint, with well over 50 delegates attending a superb session of 4 papers from members Alan Morgan and Jim Francy and also from Dominique Garmy. We have also held our first Northern Evening Seminar at Darlington – in a lull between wintry weather – with papers from members Geoff Layhe, Eric Hinsley and Martin Goosey and also from George Wheadon.

Our next event, 12th – 14th April will be our Annual Foundation Course at Loughborough University and although these are difficult times, with minimal staff turnover and recruitment, we will continue to offer this service to the Industry.

Regular visitors to our website will have seen some disruptions in the past month as we battled to reconfigure the site for a new host server, but Richard Wood-Roe has been working overtime and all modifications are now complete and the site and our InstCt.org address are back to normal.

Our participation in a bid for European funding to support a multi-partner research project into new solderable finishes (ASPIS) has finally been completed and the ICT intends to play an important role in leading the UK dissemination activities for this project. We will also be assisting with the dissemination of an IeMRC funded project entitled "Sustainable ultrasonic plating processes for photovoltaic and printed circuit board manufacture"

Our Annual Symposium this year is being held at the National Motorcycle Museum on the 15th June, on the theme of 'New and Emerging Technologies'. The price will include entry to the museum and I hope to see many of our members there.

**Bill Wilkie**

*Edited by Bruce Routledge on behalf of the*
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