



In Partnership with

Innovate UK
Knowledge Transfer Network

APCS 2018 – “Advanced Packaging for Compound Semiconductor Applications”

EVENT REPORT:

IMAPS-UK/KTN Workshop – 8 February 2018 at The Studio, Birmingham.

“Do Compound Semiconductor Applications need Advanced Packaging?”

The growing demands of increased power density, reduced form factor, enhanced performance and reduced costs for photonics, power and RF/Microwave electronics modules are challenging the traditional packaging and assembly methods. As compound semiconductor devices become more accepted, the packaging technologies must adapt to ensure that performance and system benefits can be realised.

The workshop organised by IMAPS-UK and the Knowledge Transfer Network (KTN) explored the theme of advanced packaging for compound semiconductor applications. The workshop was attended by 53 people and was held in The Studio, Birmingham. The day featured three main technical sessions, an update on the Compound Semiconductor Applications Catapult Centre and an open floor session.



Overview of Power, Photonics and RF/Microwave Packaging Needs

Liam Mills of TT-Electronics (Semelab) described the ongoing research to explore high temperature packaging of SiC devices at operating temperatures up to 400oC. The benefits of reducing the needs for cooling through running electronics at higher temperatures were discussed and results were demonstrated for high temperature die attach and wire bonding evaluations. The application of vapour deposited polymer coatings over aluminium wires showed an extended lifetime by up to x5 during power cycling.

Mike Wale of Oclaro presented a comprehensive review of the packaging needs in the photonics industry, mainly using InP devices. As demand for increased bandwidth is insatiable, there is a continuing focus on increased integration of photonics and electronics and development of flip chip, chip stacking and wafer level processing. In comparing InP based photonics with Si based photonics, the main advantage of the InP route is that high performance functionality (e.g. lasers, amplifiers, detectors and modulators) can be achieved with InP, whereas Si based photonics has some fundamental limitations.

Steve Riches of Tribus-D gave a summary of advanced packaging needs for RF/Microwave devices covering the particular packaging requirements for higher frequency operation to minimise connection lengths and discontinuities in the transmission lines. The latest packaging technologies used in 5G mm wave modules was also described.

Equipment, Materials and Processes

Andy Longford of PandA Europe described the status of electronic packages covering QFN, CSP, SiP, WLP, TSV, Flip chip and embedded device packaging. The profusion of different packaging options is challenging the established routes for manufacture; for example, wafer level packaging is generally carried out at the semiconductor foundry and embedded device packaging takes place at the circuit board level.

Hans-Georg von Ribbeck of F&K Delvotec presented their latest development in bonding equipment for high current capacity interconnections; a laser bonder. This equipment is claimed to be capable of welding larger wires and ribbons than conventional ultrasonic bonders and can be used for copper and aluminium. By combining the laser heating (through an oscillating beam) with the local force application of the bonding head, high quality joints can be made, event with poorly fitting components. The laser bonder is being applied in battery module manufacture.

Caroline Avriillier of SET described high accuracy flip chip equipment down to $\pm 0.5\mu\text{m}$ alignment. As well as equipment accuracy achieved through high resolution optics, the component needs to include alignment features and the environment needs to be stable (to overcome temperature effects).

Darren Harvey of Accelonix presented three processes that can be applied in compound semiconductor applications; sinter die attach, vacuum potting and vacuum reflow soldering.

John Govier from Inseto reviewed the solder ball jetting processes and equipment manufactured by Pactech to deposit small amounts of material for interconnection and advanced packaging applications.

Case Studies for Compound Semiconductor Applications

Andreas Schneider of STFC described the application of flip chip bonding to the assembly of GaAs and Cd(Zn)Te sensors using Au stud bumping/Ag conductive adhesive and indium bump bonding.

Mark Johnson of the University of Nottingham introduced the advantages of component embedding in low cost pcbs to optimise electrical performance, electro-magnetic shielding and thermal management. This approach is being developed in the ECOMAP Innovate-UK project.

Layi Alitase of the University of Warwick described research and work using pressure contacts in the assembly of multi-chip SiC power modules, which is continuing to be developed to demonstrate manufacturability and long term reliability.

Alastair McGibbon of the CSA Catapult gave an update of the status and plans for the initiative, covering the creation of an Innovation Centre containing a design studio, a class 10k clean room – advanced packaging laboratory and power electronics/photronics/RF/microwave laboratories. Further planning is required to define the nature of the development kits and commercial



arrangements with suppliers. The kits should represent leading edge technology and need to be planned to take into account expected advances over the next 2 years.

An open floor session was chaired by **Paul Huggett of the KTN** and touched on several topics; including existing European collaboration of photonics technology development, navigating through the various Catapult Centres to find the right organisation to help start ups, SMEs and larger organisations, emphasising the significance of packaging within the electronics and systems design communities, creating electronic packaging courses for undergraduates and post graduates at University and ensuring that the technology development programmes are directed towards the UK design and manufacturing base.

The status of the Industry Strategy Challenge Fund was summarised by **Martyn Cherrington of Innovate UK**. It is expected that a 3rd wave of funding will be announced imminently and that Expressions of Interest may be requested from interest groups to propose programmes of work to fit within the overall challenge themes. Electronics packaging could be a topic for an Expression of Interest, if there was sufficient support from the electronics manufacturing community.



Overall, this workshop was very well received by all the attending delegates, many of whom had travelled some distance. Persons from both Scotland and Wales as well as North, South and East England were in attendance, indicating the importance of this topic to the Electronics community. As a result, both IMAPS-UK and the INNOVATE KTN are considering setting up a Forum group to continue to support this segment of manufacturing.

Managed and Reported by:

- Steve Riches, IMAPS-UK Committee Member
- Andy Longford, IMAPS-UK Secretariat
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