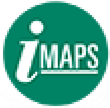
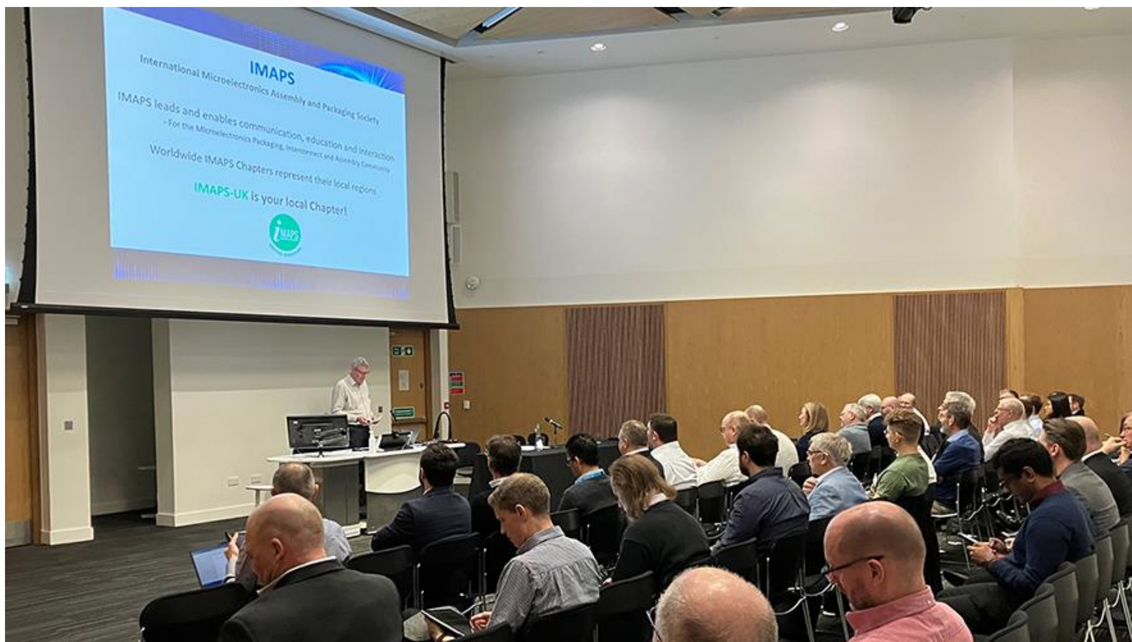


MicroTech 23 Conference – Advanced Packaging and Technology Trends

30th March 2023 – Held at the Technology and Innovation Centre, University of Strathclyde

The IMAPS-UK organised MicroTech 23 Conference on Advanced Packaging and Technology Trends explored the themes of advanced and extreme packaging, reliability, analysis and new manufacturing techniques for microelectronics manufacture.

The Conference Chair, Andrew Holland (RFMOD) welcomed participants to the event with an introduction to IMAPS-UK and a short video advertising the EMPC 2023 Conference and Exhibition to be held near Cambridge in the UK on 11-14 September 2023. **Alter Technology (MicroTech 2023 Conference Sponsor)** gave an overview of their assembly and packaging capability, located in Livingston, Scotland. The Chair then introduced the first Keynote Speaker, John Wood of Silicon Contact.



Session 1: Advanced Packaging and Trends

Keynote Presentation – Advanced, Affordable ASAP: Prototype IC Packaging Requirements for the post wire-bond age – John Wood, Silicon Contact

In an age where deep submicron integrated circuit foundry services are a commodity, advanced packaging becomes a huge differentiator between products. However, access to advanced packaging technologies for small companies during the prototype stages is a huge challenge. Of the few subcontract packaging houses which offer services, costs are prohibitive, lead times are huge and most options require full wafers - incompatible with single-die prototypes from MPW runs.

An overview of the currently available solutions (Copper bumping, Printed Copper inks (dip transfer), Nanowired TM "copper velcro") was presented and a potential strategy for electroplating copper bumps - a self-aligning system, requiring no blanket coating or lithography was outlined.

Packaging Challenges for Quantum Technologies – Andrew Robertson, Bay Photonics

Many quantum technology applications are enabled by photonic devices. Single photon detectors and sources are basic components required for both quantum based secure optical data transmission as well as quantum based optical sensing. Packaging of these devices is critical and operation at low temperature (down to cryogenic) is typically required.

The photonic packaging challenges for critical quantum enabling photonic components were reviewed and issues arising through the desire to operate in vacuum and integration of thermo-electric cooling systems were discussed.

Trends to Advanced Packaging in Power Electronics - Andy Longford, PandA Europe

Recent developments in power electronics have seen the migration away from Silicon based components to the newer, higher performance Wide Bandgap (WBG) semiconductors such as Silicon Carbide (SiC) and Gallium Nitride (GaN). To enable efficient utilisation of WBG devices, Semiconductor Packaging is changing rapidly to accommodate the advancement of these materials, the increasing power demands, higher operating temperatures and space constraints.

Roadmaps such as the recent Power Electronics Roadmap 2020 – published by the Automotive Council UK/Advanced Propulsion Centre UK in February 2021 and the IEEE Heterogeneous Integration Roadmap which released the Chapter 10 on Integrated Power Electronics also in 2021.were reviewed, highlighting the need for integration of both components and modules into systems, whilst calling for growth through standardisation.

Session 2: Extreme Packaging and Case Studies

Novel Form Factors and Encapsulation for Electronics in Healthcare – Simon Johnson, CPI

This presentation reviewed evolving technologies for unconventional build and packaging processes for electronic systems and their application to HealthTech devices. System build approaches using various flexible and structural electronics technologies such as printed electronics, fabric based packaging, in-mould electronics and thermoformed circuits were described. HealthTech devices have particular requirements including user adoption, comfort, sterility and safety, which need to be considered in any product development application.

Challenges in highly integrated mmWave packaging at E, W and D-Band - Dr Tudor Williams, Filtronic

The ever-growing hunger for data within the commercial telecoms market is driving a requirement for higher and higher frequency wireless links to backhaul the data to the core network. This presentation explained the trends and discussed some of the challenges associated with manufacturing and packaging devices in volume at E, W and D-Band. For D-band (130-175GHz) standard chip and wire, wire-bonded devices become problematic, early work to solve these challenges were presented showing experimental evaluation of potential MMIC-to-MMIC interconnects and MMIC-to-waveguide (WG) interfaces.

Deposition of Fine-Pitch Indium Bumps on Single Die Sensors and ASICs for Small Scale Fabrication of Radiation Detectors – Navid Ghorbanian, STFC

The hybridisation of sensors and read-out ASICs for the fabrication of pixel radiation detectors requires techniques such as deposition of electrically conductive interconnects and flip-chip bonding of detector components. For fine-pitch applications much smaller than 250µm, indium bumping is STFC-RAL's choice of pixel interconnect. A method was presented that permitted the deposition of fine pitch indium bump arrays (100µm or smaller) on individual die. Bump diameters of ~ 50µm have been achieved and are aligned within a few µm to the pixels of an ASIC.

Session 3: Reliability and Analysis

Keynote Presentation: Plastic Encapsulation for Harsh Environments - Szymon Bednarski, Alter Technology

The European and UK semiconductor industry have been demanding a low cost plastic package solution for microcircuits in low to medium volumes. Alter Technology UK's production line for plastic encapsulated QFNs was launched into production in 2022.

A range of open-tooled lead frames has been established for standard ASIC applications. With a range of sizes from 4x4 to 12x12 with variations of lead count. Activities towards functionality and performance of plastic devices in extreme environments are focused on testing of the modules in according with a typical standards for hermetic packaging, evaluating the performance of the epoxy mould compound against moisture as well as assessing reliability in the extreme temperature ranges.

AI and Microelectronics Reliability - Suzanne Costello, MCS Group

Reliability modelling is a well-established method to predict time to failure through accelerated life testing. This presentation showed developments in sample preparation and analytical techniques to further understanding of packaged microelectronics and associated failure mechanisms. A deep understanding of the physics of degradation is required to enable sustainability as well as reduce testing and verification efforts.

As part of the recently funded European Consortium, MIcroelectronics RELiability driven by Artificial Intelligence (MIRELAI), the methodology of a 'physics of degradation-informed machine-learning approach' for reliability along the value chain is being developed.

Session 4: New Materials and Manufacturing Techniques

Sustainable Silver Circuitry/Sensor Production using Ink Jetting and Laser Writing Methods - Dr Thomas Jones, University of Dundee

Electronics processing can be made more versatile and low-waste by the introduction of additive and selective processing techniques. A novel particle-free Ag ink solution was tailored to produce Ag circuitry from photoreduction by a continuous wave laser, and was used to demonstrate a biaxial strain sensor. The Ag ink was also demonstrated for inkjetting to produce Ag films onto polyester from thermal reduction.

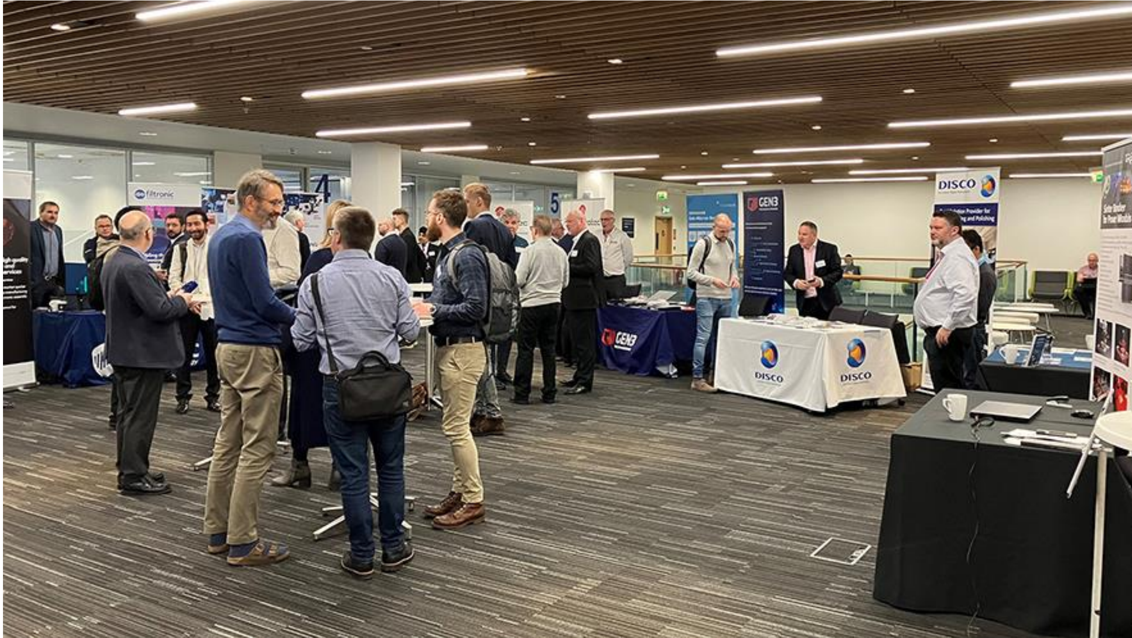
Highly conductive micropaths made from assembled 1D particle structures - Yaroslav Harkavyi, Faculty of Physics, Adam Mickiewicz University, Poland

A method was demonstrated that facilitates the continuous production of particle paths on various substrates, which involved the synergetic action of electric-field assembly, capillary, and electrostatic interactions. The as-deposited structures are characterised by low conductivity (related to a small initial contact area between the neighbouring particles) and require particle fusing. The results of the study on mechanical compression of particle chains—an approach that can be used to deform and join malleable materials and eventually obtain highly conductive micropaths of desired conductivity and height-to-weight aspect ratio was shown.

Laser Assisted Die Bonding Using a Nano-Silver Paste Material for Wide Bandgap Power Device Packaging - Binod Bhandari, Heriot-Watt University

Recent work on the development of a laser-assisted sintering method using a silver nanoparticle paste material for die attach in power device packaging applications was described. Results on the studies of assembly of silicon chips with contact pads showed that strong joints can be produced. The results of shear strength measurements, SEM analysis of fracture surfaces and cross-sections, and the effects of thermal storge were presented.

Meet the Exhibitors



The following organisations exhibited at the MicroTech 2023 Conference:

Accelonix – Specialist equipment sales and support for Microelectronics, Battery and PCB Assembly

Alter Technology - Leading provider of microelectronics and opto-electronics services in engineering, procurement, assembly and test

DISCO HI-TEC EUROPE — Semiconductor Dicing and Grinding Solutions

Filtronic—Enabling the Future of RF, microwave and mmWave

Gen3—Specialist British manufacturer and distributor of test and measurement equipment

Inseto (UK) Ltd—Manufacturing Equipment, Assembly Materials and Adhesives

Optim Wafer Services - Wafer processing services such as polishing, CMP, cleaning, thinning, re-sizing and dicing silicon wafers and other substrates

RoodMicrotec - Your Semiconductor Services Partner

Tresky Automation - Leading Machine Manufacturer for High Precision Placement Systems

For further information on forthcoming events, please visit IMAPS-UK (www.imaps.org.uk)