The Innovative Electronics Manufacturing Research Centre and its Research Projects

Martin Goosey

Loughborough University

England

The Innovative Electronics Manufacturing Research Centre (IeMRC)

- Established in 2005
- Allocated £5 million to support research in UK academia
- Strong industrial input in setting research agenda
- Currently supporting more than 30 projects
- Most projects have a significant industrial input

The IeMRC Mission

To establish a ‘Centre of Expertise’ through which UK industry can access and influence research in electronics manufacturing

IeMRC
Innovative electronics Manufacturing Research Centre

The IeMRC Research Strategy

- The IeMRC has a research strategy guided by a group of UK electronics industry experts
- in the form of an Industrial Steering Group representing all sectors of the UK electronics industry supply chain
- The IeMRC also participates in DTI supported strategic projects and activities such as;
  - The Electronics Innovation Growth Team (EIGT)
  - Global Watch Missions
  - Knowledge Transfer Networks
  - DTI Technology Programme

IeMRC Innovative electronics Manufacturing Research Centre

IeMRC Research Themes

- Design
- Packaging, materials and technology
- Assembly, manufacture and test
- Integration of disparate technologies, including design and manufacture
- Reliability
- Business Issues
- Environmentally Friendly and Sustainable Electronics

Project Selection criteria

- Impact on UK manufacturing
- Relevance to chosen themes and needs of industry
- Track record of consortium
- Synergy with other R&D projects
- Degree of innovation
- Quality of planning and research
- Value for money and matching funding from industry
- Level of industrial involvement
- Dissemination and technology transfer

Example IeMRC Electronics Projects

- Power Electronics Flagship
- Lithographically printed circuits, batteries and displays
- System in Package
- Lead-free solders, assembly and reliability
- Reduced emission PCB manufacturing processes
- High resolution resists for processing silicon

IeMRC Electronics Project Examples

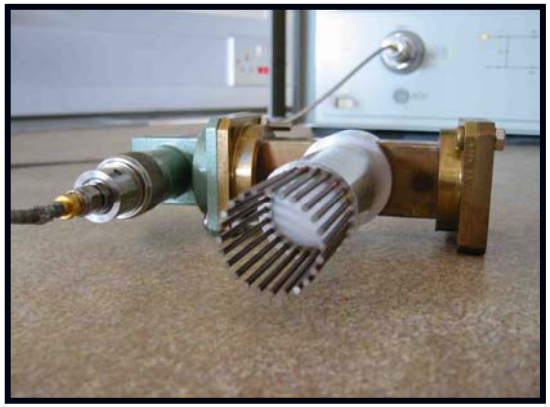
Example 1

Heriot Watt University

Frequency Agile Microwave Oven Bonding Systems (FAMOBS)

- To manufacture a device in a partially open, variable frequency microwave oven
- To be installed on the arm of a high-precision machine for micron accuracy alignment capability
- Simultaneous alignment, curing & bonding
- An IeMRC 18 month project following a successful feasibility study (Feb - Aug 2006)

Industrial Partners, Sponsor and Prototypes



Henkel

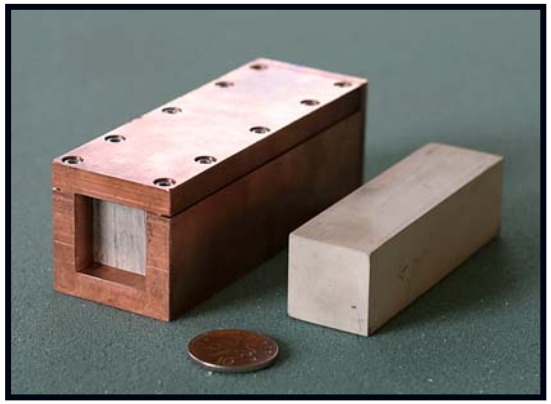
Bookham

RENISHAW apply innovation™

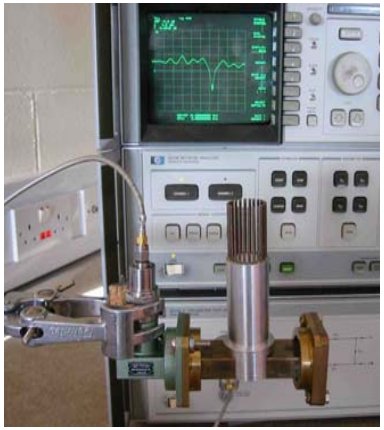
MCE

NPL National Physical Laboratory

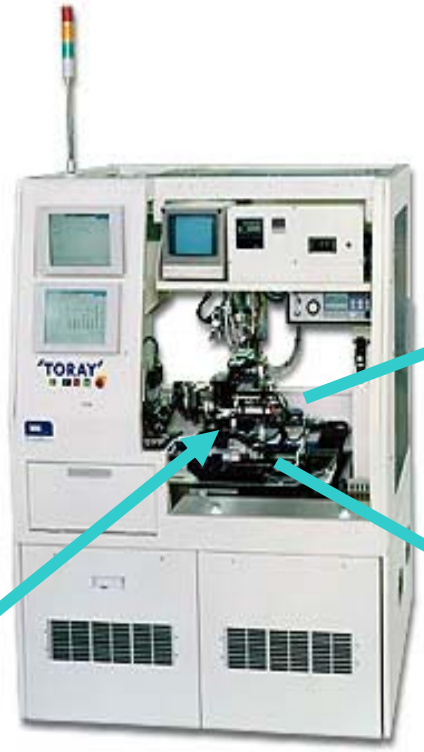
IeMRC Innovative electronics Manufacturing Research Centre



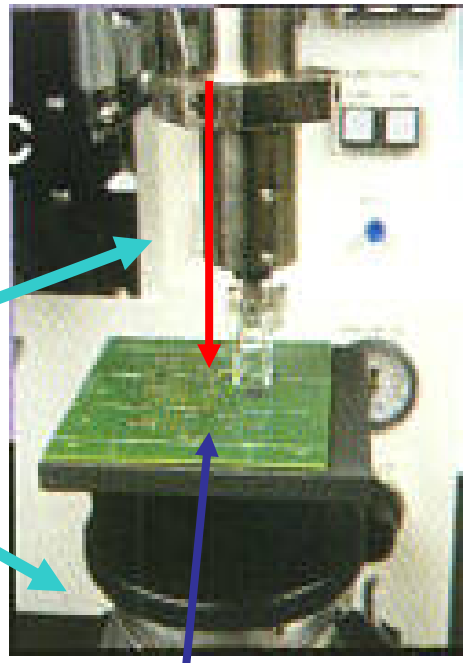
The FAMOBS Concept



Open Cavity Oven



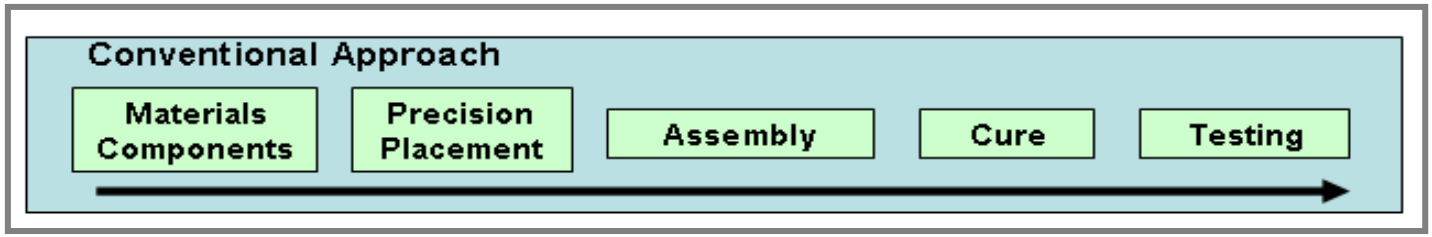
Microwave Heater on Die Placement Arm



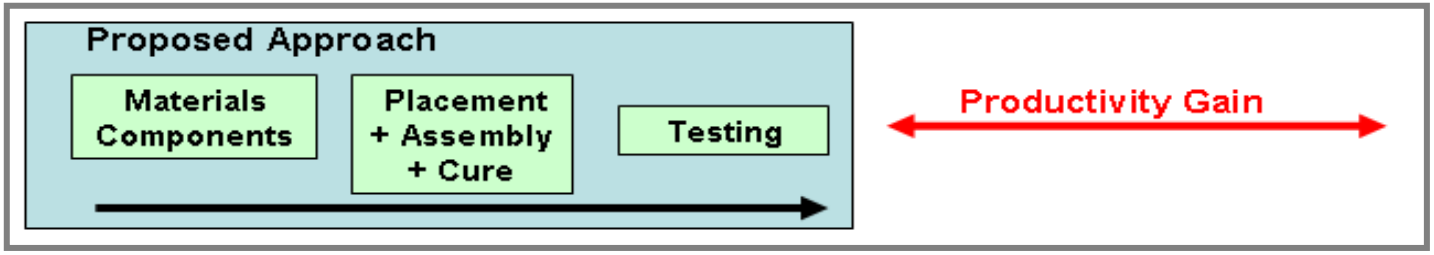
Die, Adhesives, Encapsulants, Underfills, etc

FAMOBS - Productivity Gain in Packaging

Traditional packaging process



FAMOBS packaging process



IeMRC Electronics Projects

Example 2

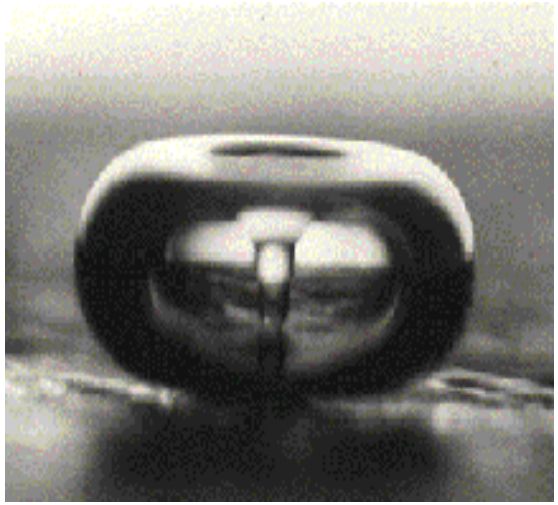
Coventry University

Sonochemistry Research at Coventry

- Good adhesion is required at many interfaces used in electronics manufacturing, eg metals on polymers
- This is typically achieved by the use of aggressive and environmentally undesirable chemical processes
- An alternative method being developed at Coventry is to use sonochemical routes to offer more benign processes
- Use of ultrasonics can reduce process temperatures and generate less waste etc

Acoustic Cavitation - the Driving Force for Sonochemical Surface Modification

- **Microjetting**
  - mechanical/physical attack of surface
  - scrubbing/cleaning action
  - destruction of boundary layers
  - movement of reactants to, and products away from, the surface
- **Extreme temperatures and pressures**
  - chemical/oxidative attack of the surface due to oxidative species
  - breaking of bonds on surface of material
  - chemical reactions on surface



Innovative electronics Manufacturing Research Centre

Results on Materials Used in Electronics

Ceramic material

Ultrasonic conditions more significant than chemistry of solution for surface modification. Can be surface modified sonochemically in water

Noryl (PPO)

Can be surface modified sonochemically in water but solution chemistry also important

Cycolac (ABS/PC)

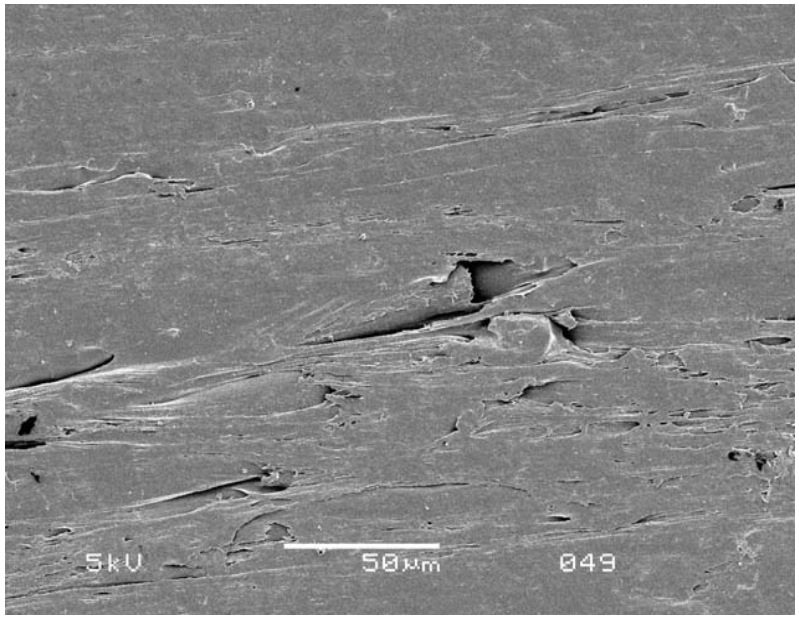
Chemistry of solution most significant factor in surface modification. Ultrasonics have little affect under these experimental conditions

Duraver (FR4 Epoxy)

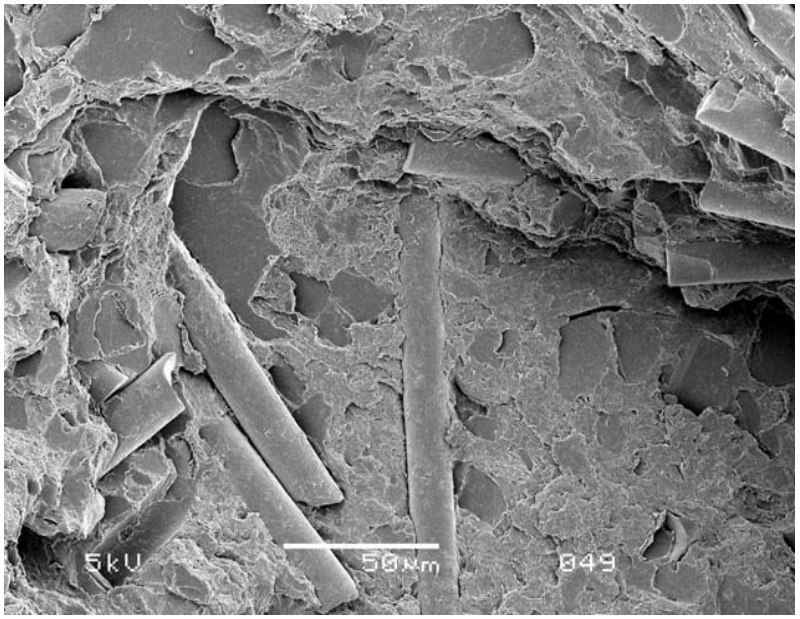
Solution chemistry important, but surface modification enhanced by ultrasonics

Texturing the Surface of Noryl (PPO)

Silent



20 kHz Ultrasonic Probe



Noryl samples textured in DI Water (40°C for 60 minutes)

Magnification x 500

Courtesy Andy Cobley

IeMRC Electronics Project Examples

Example 3

Bath University

IeMRC Innovative electronics Manufacturing Research Centre

Cost Estimation for Low Volume Long Life Products in Electronic Defence Systems

Project Research Aims

- To develop and evaluate a methodology that provides a framework for through-life cost estimation and forecasting

- To provide a hybrid approach to cost forecast / estimate for defence systems providing a ‘rough-cut’ cost estimate based on low detail at the concept design stage of product design

- To accept greater detail to improve the cost forecast accuracy and estimate progressively through the design and realisation process

  AND during operation, maintenance, replacement and disposal

Key Industry Findings

- In cost estimation there seems to be a lack of an auditing standard to validate the process
- Almost 90 % of the companies did not use proprietary cost estimation systems, instead they simply used ‘spreadsheets’ to perform their cost estimation processes
- The majority of the companies indicated that there was a lack of cost estimating training and support
- The key difficulties in implementing cost estimation were due to two common problems:
  - estimates with insufficient information
  - the results that do not reflect the actual cost

IeMRC Links

- SUMEEP
- SMART
- ICT
- ITIC
- UK Displays and Lighting Network
- Resource Efficiency KTN
- Electronics Enabled KTN
- DTI Technology Programme
- Circuit World and Soldering and Surface Mount Technology

IeMRC Outside UK

- Participation in Global Watch European technology mission
- DTI Mission to Poland on electronics recycling
- DTI Global Watch mission to the USA on Thermal Management
- Links with Chalmers University, Sweden

IeMRC Innovative electronics Manufacturing Research Centre

Summary and Conclusions

- The IeMRC is supporting research across all parts of the product lifecycle form design to end of life
- Projects are running at universities around the country
- The IeMRC would like its work to be exploited by industry
- We would welcome the opportunity to work with industry in further collaborative projects such as the DTI Technology Programme and the 7th Framework

IeMRC Innovative electronics Manufacturing Research Centre

Want to Know More?

Then come

to the

IeMRC Annual Conference

in

Loughborough

5th September 2007

IeMRC Innovative electronics Manufacturing Research Centre

IeMRC Projects

m.goosey@lboro.ac.uk

http://www.lboro.ac.uk/research/iemrc

Martin Goosey

Loughborough University

England

IeMRC Innovative electronics Manufacturing Research Centre