High Temperature Solders - Expert Survey Results

19th February 2008

ITRI/Soldertec

- ITRI – formerly International Tin Research Institute
- Funded by tin producers
- Soldertec – membership consortium, global solder manufacturers
- Pioneer in lead-free soldering research – 1991
- Coordinator of ELFNET (European Lead-Free Soldering Network) 2004-2007
- HT Solders topic now being discussed by members
- No viable solution yet

Outline

- Developed by
  - Dag Andersson, Swerea IVF
  - Jeremy Pearce, ITRI/Soldertec
  - Ales Kroupa, COST MP602
- Circulated to
  - ELFNET Solders TEG (113 members)
  - ELFNET Components TEG (76 members)

Aims

- To generate expert feedback for use by COST MP0602 at Genoa meeting
- To gauge real industry and research experience and opinions
- Sections
  - General situation (Opinions, pressures, experience)
  - Materials/Technology (Candidates, applications, knowledge gaps)
  - Remarks
  - Company information

5 Responses

- Zarlink
  - UK components SME
- Elektroniikan 3K-tehdas
  - Swedish CEM SME
- NXP Semiconductors
  - Major Dutch semiconductor company
- Helsinki University of Technology
  - Leading lead-free soldering RO
- TUBITAK
  - Turkish government RTD

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General Situation

Zarlink

- 95Sn5Sb seems possible
- Traditional soldering the most likely solution
- Legislative pressure within 5-10 years
- Materials issue the main one
- Zarlink has no knowledge in this area

Elektroniikan 3K-tehdas

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- Difficult to find replacements, lack of good alloy candidates
- New approaches welcome IF they work in practice
- Don’t know about legislative pressure
- Materials the main issue
- 3K has some experience from tests

NXP Semiconductors

- Limited material choice so high-lead will remain in use near future
- No obvious replacement so RoHS exemption will stay
- Any new solution needs 6 months for full qualification
- Non-traditional approaches have highest chance but process parameters must fit current
- Legislative pressure in distant future
- Costs the major issue
- No activity yet at NXP

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- Very difficult to replace – strict requirements
- SAC, BiCuAg(Sn) OK on mpt. Mechanical properties of high Bi, IMC likely not adequate
- Quaternary+ systems not feasible – compositional control quite difficult
- Transient liquid bonding may offer some solutions, but time required for final stage too long
- Nanomaterials + adhesives may be most relevant for future but problems – much research needed
- Legislation in 5-10 years
- Materials the main issue
- HUT have experience from tests

TUBITAK

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- Legislation will ultimately remove lead, except for military etc
- Reliability needs special consideration, study and results
- Patent issues with new formulations
- Costs greater
- New improved technologies necessary
- New approaches possible – nanomaterials, liquid phase sintering
- Very strong pressure in near future
- Materials, patents, costs, technology important
- No activity at TUBITAK yet

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Materials & Technology

Zarlink

- Most promising Sn5Sb?
- Applications
  - Flex hybrids (200'C)
  - Ceramic hybrids (225'C)
- No sustainability, legal issues with elements
- Knowledge gaps
  - Lack of materials
  - Lack of materials property info
  - Lack of solder/substrate interface behaviour
  - Long-term stability (reliability)
- Lacking
  - Process and yield problems

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- Various alloys used –user does not know reliability
- Applications
  - Ceramic BGA components
  - Column Grid Array (CGA) components
  - Pb-free soldering litz wires (>400'C soldering)
- Sb not more hazardous than Ag etc, but experienced some customers not accept Sb in 'green' products
- Knowledge gaps
  - Lack of materials
  - Lack of materials property info on existing solders
  - Long-term stability (reliability)

Elektroniikan 3K-tehdas

- Lacking
  - Reliability
  - Cu dissolution
  - Compatibility with other materials and soldering equipment

NXP Semiconductors

- Most promising CuSn (>3% Cu)
- Applications
  - Die attach for power applications (300'C)
- AuSn (80/20) can be used but Au not environmentally friendly. Semiconductor industry cost-driven – cannot be used for commodity goods
- Knowledge gaps
  - Combination of all, related to current process settings
- Lacking
  - Alternative systems with proper reliability & processability

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- Most promising BiCuAgSn but problems with mechanical properties
- Applications
  - Automotive (260-350'C)
  - Component inner connections (260-350'C)
- No issues expected with proposed elements
- Knowledge gaps
  - Lack of materials
  - Lack of solder/substrate interface behaviour
  - Long-term stability (reliability)
- Lacking
  - Mechanical properties under multiaxial stress (low and high strain rate)

TUBITAK

- Most promising, Sn97Cu3, Sn95Ag5, Sn95Sb5, Sn25Ag10Sb, Sn20Au
- Applications
  - Automotive (225-300'C)
  - Aerospace (<460'C) Venus mission
  - Oil/Gas (<250'C)
- Sustainability/legal issues expected with elements
- Knowledge gaps
  - Materials
  - Materials info
  - Solder/substrate interface behaviour
  - Long-term stability (reliability)

TUBITAK

- Lacking
  - Fatigue behaviour at high temperature
  - Long-life data
  - Standardisation issues (new standards preparation)
  - Recycling
  - Repair
  - New fluxes
  - Workmanship
  - HT Soldering process technology

Remarks

- Zarlink
  - I think there will be more RoHS exemptions
  - Attempt should be made to forecast whether these are likely
- TUBITAK
  - Research is necessary on failure mechanisms at high T

Conclusions

Conclusions

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- Topic is challenging..
- No agreement on promising solutions – ?application specific
- SnAu available but undesirable
- Varying views on legislative urgency – needs clarification
- New approaches looked for but problems foreseen
- Materials the main issue, but cost must be considered
- Some testing experience only
- Sb may be a problem for some customers
- Application focus differs – will determine solution
- Many inter-related knowledge gaps
- Real-world issues must be included – processability, compatibility, failure…
- Reliability a key topic