NPL
National Physical Laboratory

Microelectronics *News*

A National Measurement Newsletter

Spring 2005 | Issue 21

An essential part of NPL's work has always been its involvement in measurement standards' activities. The outputs from its core programmes are constantly fed to the relevant authorities to help create new standards where none exist but are necessary, or to update existing standards.

Nowhere is this more valuable than in electronics interconnection, where NPL is helping to generate new methods (e.g. for CAF - conductive anodic filaments, and for tin whiskers), and to modify exiting methods (e.g. processing of pcbs using lead-free soldering technology). NPL has representatives on relevant BSI, IEC and IPC committees dealing with measurement and test methods in electronics assembly technology, and has been able to exercise considerable influence in these areas, particularly regarding lead-free processing, and SIR measurements. However, there are always opportunities for other UK organisations to be involved, either directly as committee members, or indirectly via NPL. Further information is available on request.

Chris Hunt

This Issue:

Webcast – ROHS Legislation and Supply Chain Issues 1

SSTC Focuses on Lead-free Soldering Technology 2

Do You Have Questions About the Transition to Lead-free Product? 2

Forthcoming Events 2

I'm Exempt – Can I Relax? 3

Predicting Tin Whisker Growth 3

New Appointment Strengthens EI Team 4

Stress Screening for Conductive Adhesives 4

Webcast – ROHS Legislation and Supply Chain Issues

It may not be technical aspects that hinder successful transition to lead-free soldering. Non-technical aspects, such as dealing with subcontractors, customer and stock control, will be just as critical. Since in many cases these have received only passing attention, NPL has prepared a major Webcast to highlight the potential non-technical pitfalls and to help in the preparation of plans to address them. The presentation also deals with other difficult questions, such as

- Are you a producer under the WEEE/ROHS Directives?
- What responsibilities will you accept as a supplier, or pass on as a customer?
- Who owns the bill of materials (BOM) for your product?
- Who ensures the product will be compliant?
- What actually needs to be in place by July 2006?
- What is the definition of lead-free, and are you exempt?

The experience gained in the many 'health checks' NPL has carried out around the country will be available during the hour long Webcast on 26th April 2005. To be involved contact Roger Hughes (020 8943 6164 or roger.hughes@npl.co.uk).

Contact: Alan Brewin,
Tel: 020 8943 6805
Fax: 020 8614 0428
E-mail: alan.brewin@npl.co.uk

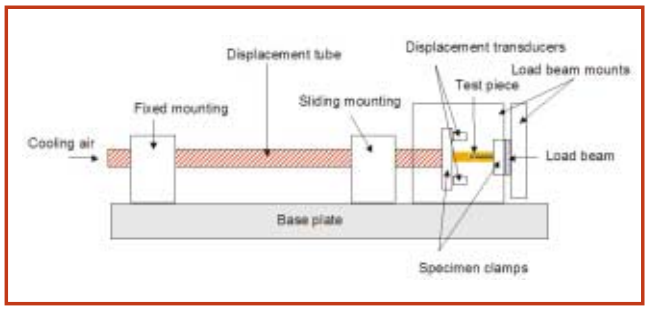
E-mail Delivery

In response to an increasing demand and popularity for *Microelectronics News*, future issues will be remain free of charge, but will be delivered electronically. This is the last issue that will be delivered by post. To ensure you still receive your copy, you will need to complete the attached sheet (giving simply your name, your company and your e-mail address).

dti
FUNDED BY THE DTI

SSTC Focuses on Lead-free Soldering Technology

As 1st July 2006 looms large on the horizon, the thirst for more information on lead-free soldering technology gathers pace.



Test set-up for generating materials data on micro-joints – see Issue 20.

It was appropriate therefore that the winter meeting of the Soldering Science and Technology Club (SSTC) was dedicated to this area of industrial concern. A non-technical start to the meeting was provided by James Lingard (DTI) who reviewed the ROHS directive and underlined recent issues originating from the EU or consultation exercises. The first of nine technical presentations was given by Chris Hunt (NPL) who highlighted the difficulties of using X-ray diffraction techniques to predict the propensity to tin whisker growth. Subsequent presentations ranged from reviewing recent models of fatigue and creep in lead-free solders (Steve Ridout, Greenwich University), through the measurement of voiding in lead-free pastes Martin Wickham, (NPL), to a new approach to the overmoulding of electronics with recyclable polymers (David Whalley, Loughborough University). These soluble polymers not only appear to be promising functionally, but also meet end-of-life requirements.

Not surprisingly, the reliability of lead-free joints was a major interest, and attracted several papers. Milos Dusek (NPL) looked at the effect of microstructure, PCB finish and processing on joint reliability and proposed a new approach for measuring tensile, creep and fatigue properties in a single machine. James Oliver (SIMR) outlined recent results on the fatigue properties of lead-free solder joints and presented a theory for the microstructural degradation of lead-free solder joints and those contaminated with lead. He reported that 2-5% Pb contamination can reduce the lifetime of

Degradation of via (SnAg solder and ENIG board finish) after 2000 cycles.

lead-free joints due to hindering the tin grain growth. The contamination issue was taken up by Martin Wickham who reviewed literature data on the distribution of the lead in contaminated lead-free joints, and outlined the progress of an NPL collaborative project (15 partners and other assisting companies – see Issue 20). Oliver also reported on some interesting measurements of compatibility of lead-free solder with various lead-free metallisations (immersion tin, immersion silver, Au on ENIG Ni, OSP).

Contact: Chris Hunt
Tel: 020 8943 7027
Fax: 020 8614 0428
E-mail: chris.hunt@npl.co.uk

Do You Have Questions About the Transition to Lead-free Product?

The NPL web page on "The Most Frequently Asked Questions" has received so many hits that it has been updated and extended.

It now poses the "Top 37 Questions" and supplies answers and advice on a range of topics relevant to lead-free soldering including the WEEE/ROHS directives, compliance, solder replacements, equipment upgrades, component compatibility, reliability, and training. (www.npl.co.uk/ei/news/faqs.html)

Contact: Alan Brewin,
Tel: 020 8943 6805
Fax: 020 8614 0428
E-mail: alan.brewin@npl.co.uk

Forthcoming Events

The SSTC and EMA are joining forces to organise a major conference on 5th May 2005 - Printed Circuit Boards in Today's High Frequency (HF) and High Density Interconnects (HDI) Applications.

Meanwhile, the next in the series of SSTC Meetings will be held at NPL on 13 July 2005

Contact: Chris Hunt
Tel: 020 8943 7027
Fax: 020 8614 0428
E-mail: chris.hunt@npl.co.uk

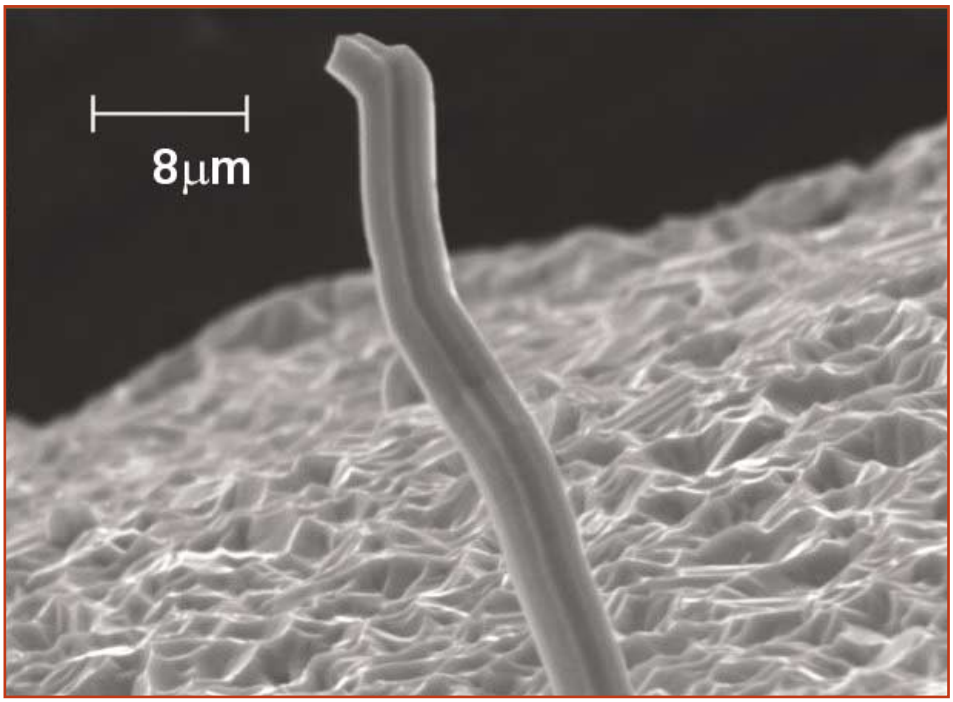
I'm Exempt - Can I Relax?

This question is regularly posed during industry visits regarding lead-free soldering awareness-raising and compliance issues.

The answer is a firm no. The status of exempt applications is under constant review, and furthermore it should not be assumed that the customers won't want lead-free product – it's better to ask them. After July 2006 lead-containing parts may become difficult to source. Moreover, as green issues are more widely appreciated, the combination of market push and public perception may result in a customer's preference for lead-free product. Sourcing your BOM (Bill of Materials) may also change and you must be aware of the ramifications this may have on your processing. For example, pure tin coatings, so long banned by the military, are now gaining widespread use as a replacement for SnPb coatings. In addition, it may be difficult to source BGAs other than with lead-free balls, and these are known to pose assembly difficulties using a conventional lead-containing process. Some manufacturers who have an exemption, but are anxious not to be seen as "non-green", are using this current advantage to clarify their future policy and requirements.

Contact: Alan Brewin
Tel: 020 8943 6805
Fax: 020 8614 0428
E-mail: alan.brewin@npl.co.uk

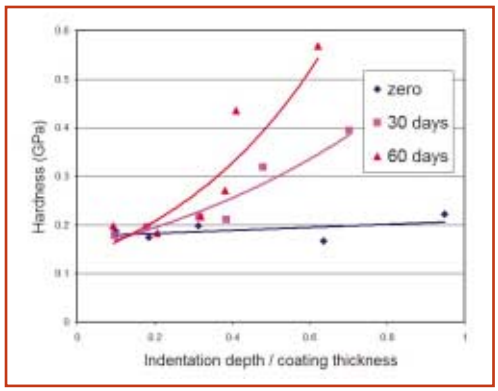
Predicting Tin Whisker Growth



Early stage of tin whisker growth.

For decades the industry has needed a method to predict whether or not component and board platings would grow potentially damaging whiskers during service, and interest has heightened following the wider acceptance of pure tin as a component finish.

The current method is slow and subjective, requiring a soak (4000 hours at 60°C and 85% RH) and optical inspection. Speedier techniques are clearly desirable. The mechanisms for whisker growth depend on a stress driver, suggesting X-ray diffraction methods to measure any internal stress. But a study of the technique has shown that although there was some correlation of measured compressive stress with observed whisker growth, the data were restricted to very thin coatings – a major shortcoming for practical tests. However, a new Studio project has been prepared to assess nano-indentation, a technique capable of characterising internal stress in thicker tin coatings down to the substrate interface where whisker growth is initiated. There are opportunities to join this short-term collaborative work (e.g. to explore different coating chemistries), and interests in participation or comment on content are welcome.



Coating hardness as a function of coating thickness and ageing at 50°C.

Contact: Chris Hunt
Tel: 020 8943 7027
Fax: 020 8614 0428
E-mail: chris.hunt@npl.co.uk

Any comments and views on this newsletter, or requests for further copies should be addressed to;

Materials Enquiry Point
Tel: 020 8943 6701 | **Fax:** 020 8943 7160 | **E-mail:** materials@npl.co.uk
National Physical Laboratory | Teddington | Middlesex | United Kingdom | TW11 0LW
Helpline: 020 8943 6880 | **Fax:** 020 8943 6458 | **E-mail:** enquiry@npl.co.uk

Stress Screening for Conductive Adhesives

As a result of an NPL-industry collaborative project, material and processing engineers are a major step nearer being able to credibly assess any new ICAs (isotropic conductive adhesives) for interconnection purposes. The study has demonstrated the effectiveness of a readily applied stress screen test. The study involved examining joints on test boards produced from a matrix experiment using two ICA materials, a range of components, eight ageing regimes, and four assessment techniques (electrical conductivity, shear testing, drop testing and SIR). Salient results :

- the performances of the two ICA materials were broadly similar – the resistances of the bulk materials were stable over all testing regimes
- the materials performed well as interconnect materials, particularly when subjected to thermal cycling, exceeding the expectations of typical end-users
- the parameters of an appropriate stress screening regime, are unbiased joints, 85°C, 85%RH, for 1000 hours
- this test provides a means of differentiating between the effects of assembly parameters, particularly for leaded SM components
- other candidate screening regimes studied all exhibited significant drawbacks

The project is being extended to study the effects of bias on the ICA joints during testing. Moisture is expected to play an important role in the likely failure modes experienced by biased joints, underlining the suitability of the recommended test regime.

Contact: Martin Wickham
Tel: 01292 719288
Fax: 01292 719287
E-mail: martin.wickham@ntlworld.com

New NPL Reports

- Developing a Test Method to Characterise Internal Stress in Tin Coatings, NPL Report DEPC-MPR 014
- Developing a Stress Screening Regime for Isotropic Electrically Conductive Adhesives, NPL Report DECP-MPR 005

New Appointment Strengthens Electronics Interconnection Team

Angela Mensah

The Electronics Interconnection Group at NPL has been further strengthened with the appointment of Angela Mensah. Her extensive background in corrosion will be invaluable to current and planned programmes on studying the performance of conformal coatings in corrosion protection of electronic assemblies. The main aims of these programmes (see Issue 19 July 2004) include

- the identification of potential protection mechanisms in conformally coated assemblies
- assertion of the levels of protection offered by a range of materials
- generation of reliable test procedures to measure the degradation effects on electronic assemblies in aggressive environments
- contribution to more effective standards for engineers designing and specifying these products

Contact: Angela Mensah
Tel: 020 8943 6759
Fax: 020 8614 0428
E-mail: angela.mensah@npl.co.uk

For more details visit our web site: www.npl.co.uk/ei

5702 / AAR16710 / 3.2K / 0405