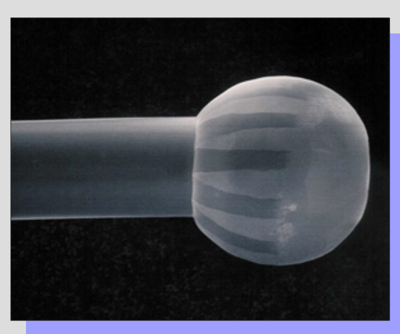
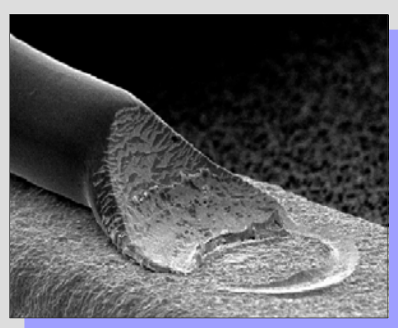
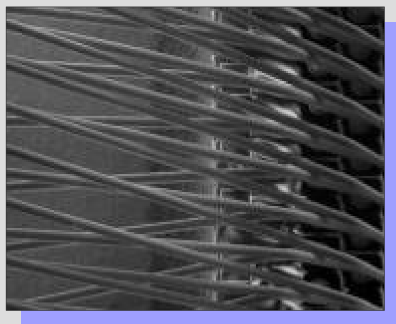
# Microbonds X-Wire™ Technology Overview







May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# X-Wire™ Technology

- Enables Cost Effective Solutions to Today's Packaging Challenges
- Leverages Current Wire Bonding Knowledge, Infrastructure and Supply Chain
- Extends Ability of Wire Bonding to Address Geometry, Density and Yield Requirements
- Flexible, Proven Technology that Uses Tanaka's Industry Leading Bond Wires

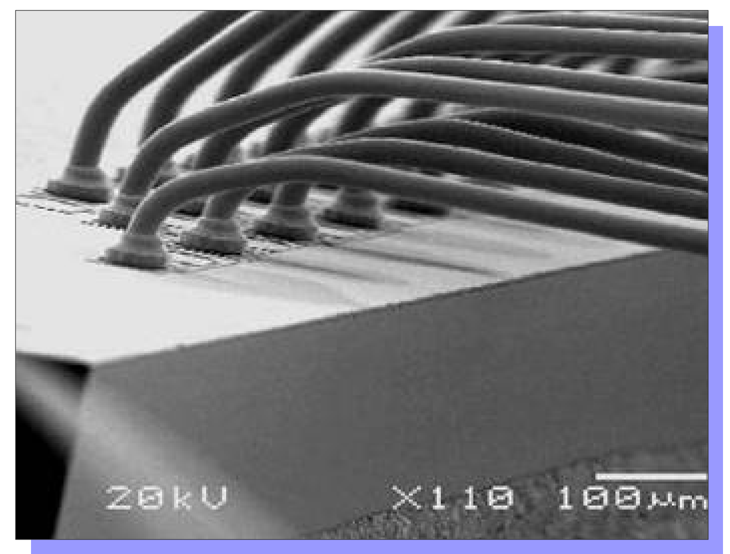

Copyright ©. All Rights Reserved

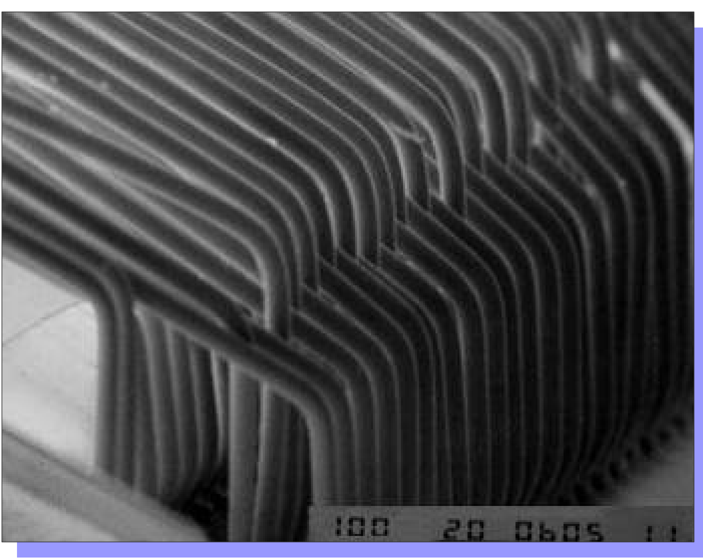
# Microbond's X-Wire™ Technology Insulated Wire Bonding

- Removes Limitations to Current Wire Bonding Design Rules
- X-Wire™ Technology Allows:
  - Crossing Wires
  - Touching Wires
  - Long Wires
  - Wire Sweep
  - Corner Wires

May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# Bare Wire Vs X-Wire™



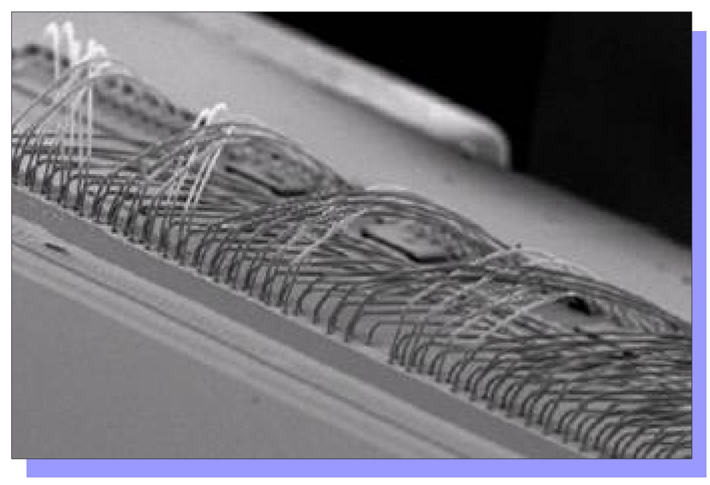



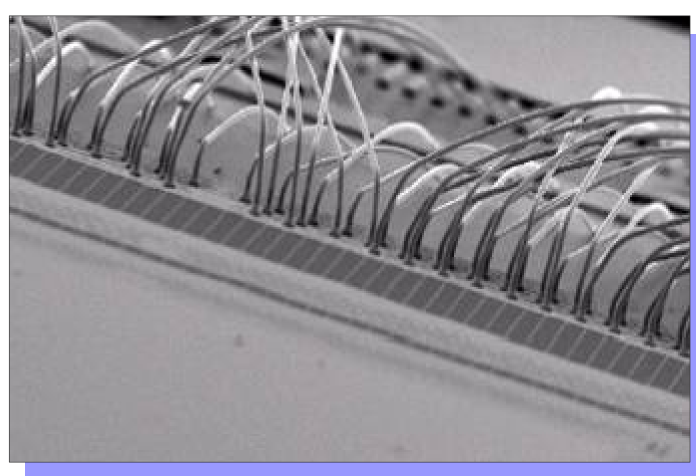
**Bare Wire**

**X-Wire™**


Copyright ©. All Rights Reserved

# X-Wires™ - Broadens Wire Bonding Rules

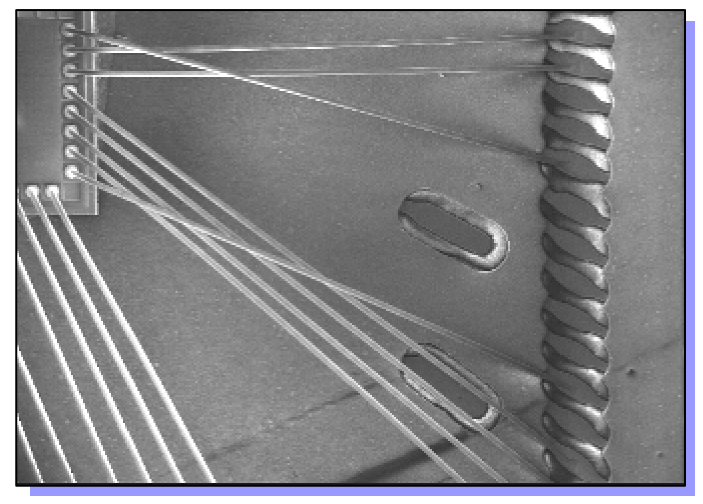


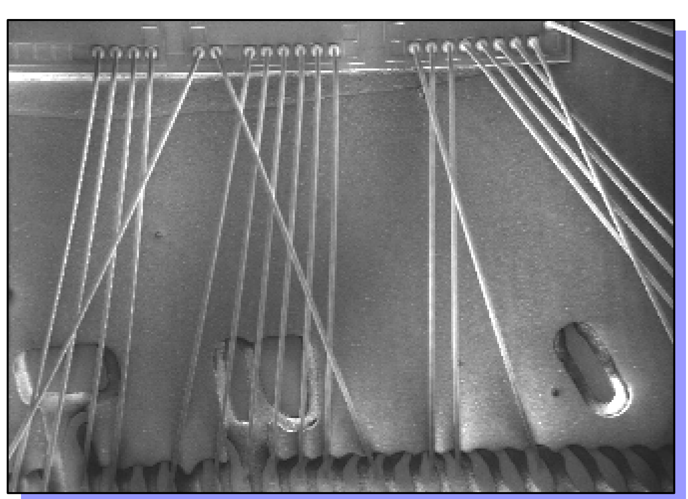


- Actual Test Vehicle Used in Reliability Testing
- Over 500 Crossed Wires per Package


Copyright ©. All Rights Reserved

# X-Wires™ - Long Wires Can Cross & Touch

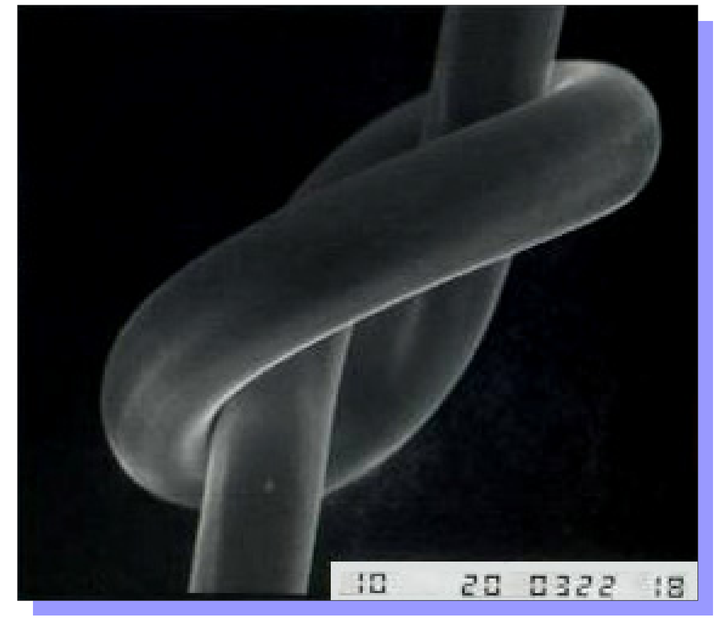


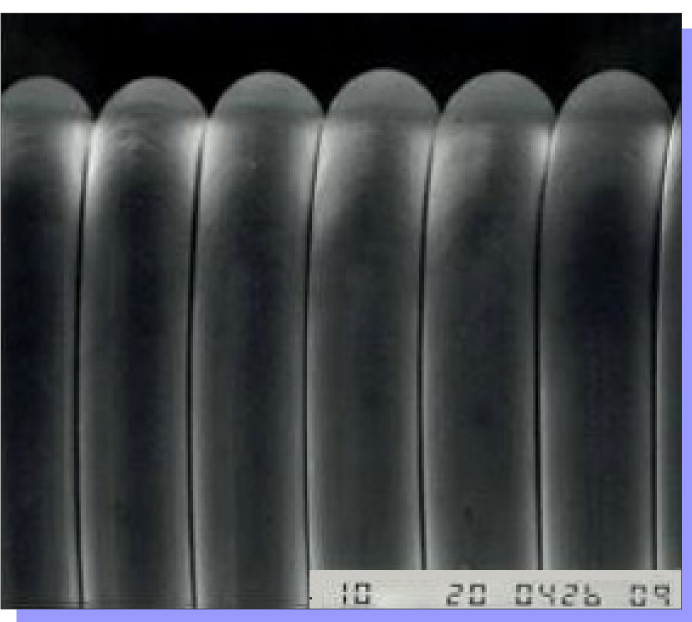


- Long Wires Crossing & Touching
- Long Corner Wires Crossing & Touching

May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# X-Wire™ Simplifies Wire Looping

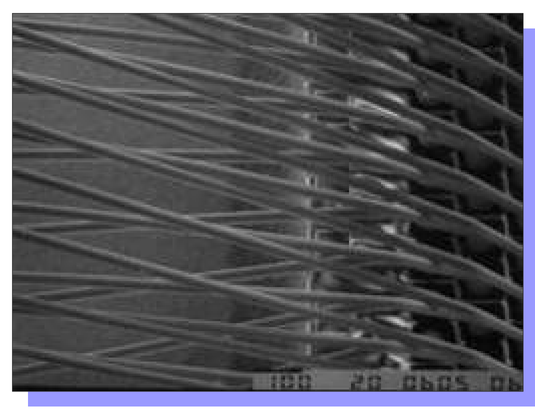


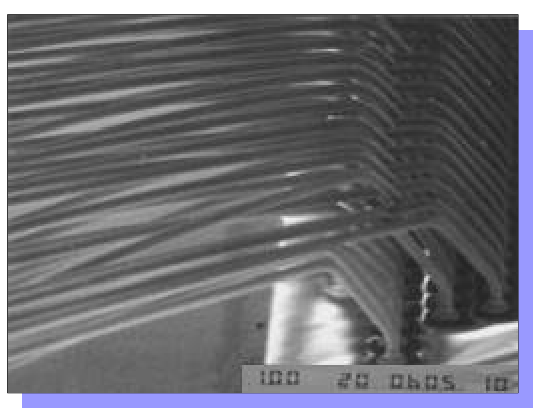



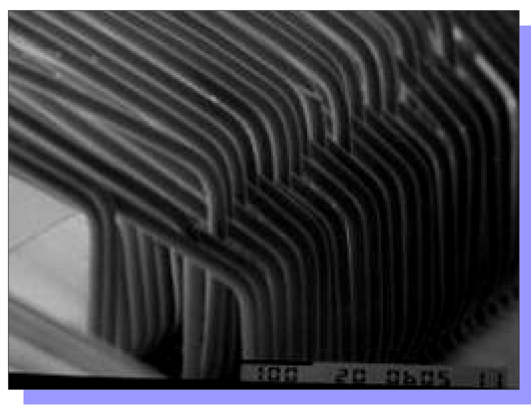

- X-Wire™ Insulation Coating Features
  - Excellent Adhesion and Flexibility
  - No Cracking or Flaking

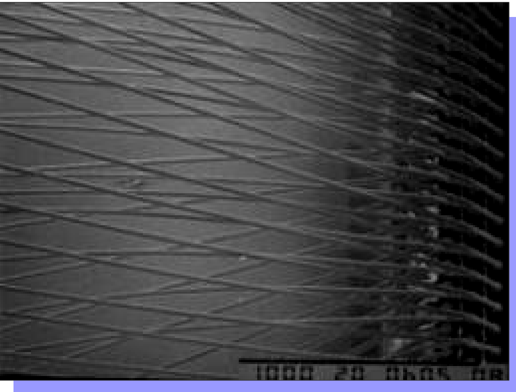

Copyright ©. All Rights Reserved

# X-Wire™ Enables Advanced Packages









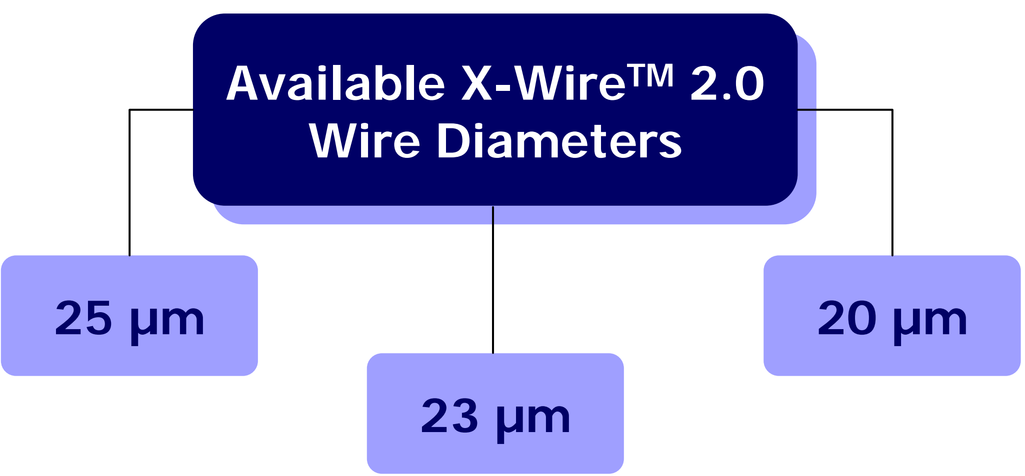
May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# X-Wire™ Benefits

- Relax IC & Package Design Rules
- High Performance, Low Inductance Pkg
- High I/O & Array Area Bonding
- Enable System in Package - SiP
- Enable Complex Stacked Die
- Reduction of Die Size
- Lower Substrate Cost
- Fine Pitch Wire Bonding
- Enable Long Wires
- Increased Reliability
- Increased Assembly Yield
- No New Infrastructure


Copyright ©. All Rights Reserved

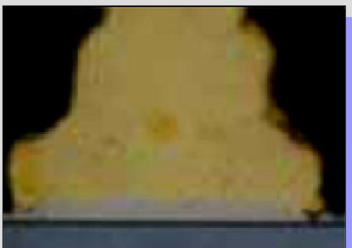
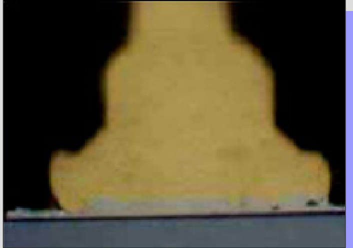
# X-Wire™ Benefits




| Wire Diameter | 25 µm | 23 µm | 20 µm |
|---|---|---|---|
| Pitch Capability | 60 µm | 50 µm | 45 µm |
| Wire Bonder Platform | ASM Eagle / K&S Maxum | | |


Copyright ©. All Rights Reserved

# X-Wire™ IMC Data

# IMC of X-Wire™ at 0 hrs

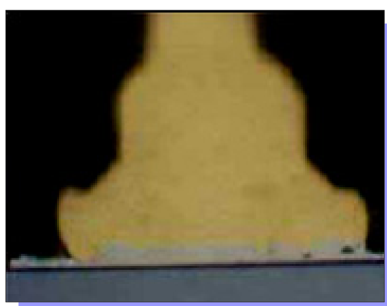
| > 85 % | > 75 % | > 95 % | > 85 % |
|---|---|---|---|
| > 80 % | > 85 % | > 90 % | > 90 % |
| > 90 % | > 80 % | > 80 % | > 90 % |

May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# IMC of X-Wire™ After Aging

X-Wire™

| After Baking Test at 175°C | | |
|---|---|---|
| 0 hr | 96 hrs | 192 hrs |



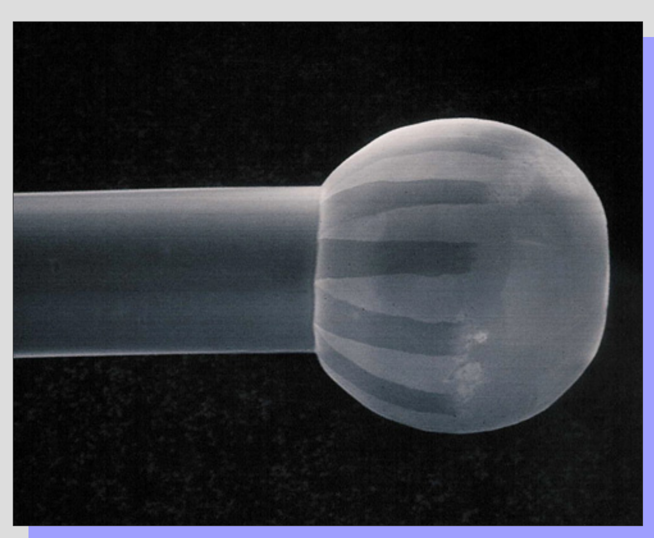

Copyright ©. All Rights Reserved

# IMC Summary

- Greater than 70 % IMC Coverage
- Intermetallic Forms Easily *Through Coating* on Bonded Ball
- Passed 0 hr, 96 hrs & 192 hrs Aging Test at 175$^{o}$C

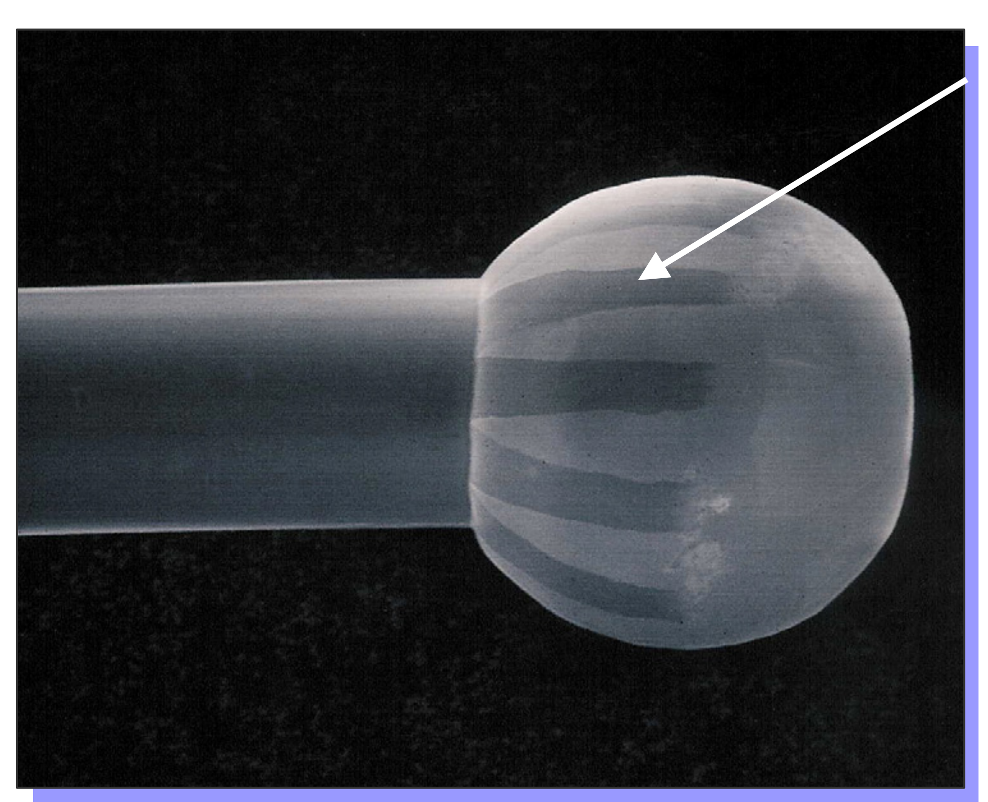

Copyright ©. All Rights Reserved

# X-Wire™ Ball Bond Data



# X-Wire™ Free Air Ball

X-Wire™



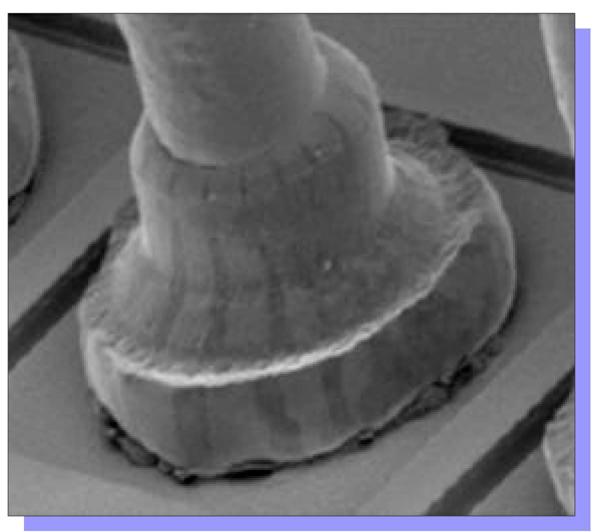
- Stripes Indicate Coating Presence
- Wire is Fully Coated Right Down to Neck
- No Melting of Coating Material

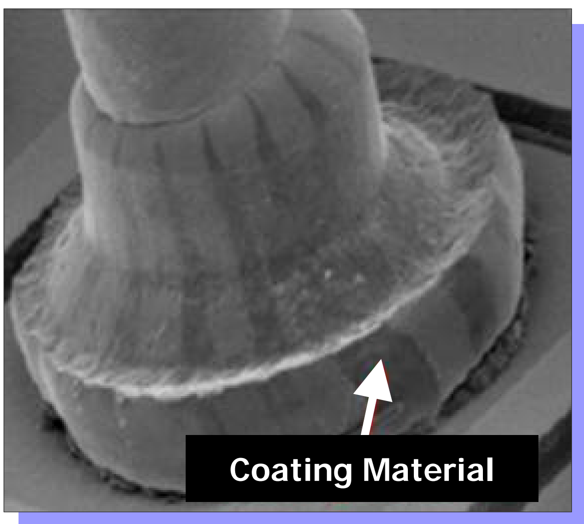

Copyright ©. All Rights Reserved

Microbonds

# X-Wire™ Bonded Ball

- Presence of Coating on the Ball Bond







Copyright ©. All Rights Reserved

# X-Wire™ Ball Shear Data

**Ball Shear Data**

Ball Shear (g/mil²)

8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

Min
Avg
Max

20 µm
23 µm
25 µm

Diameter Size

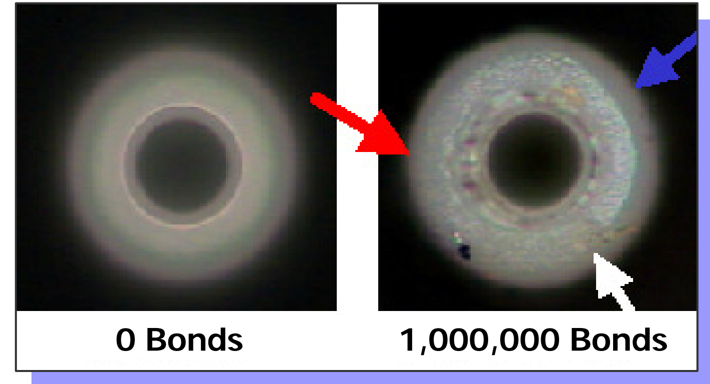
May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

Microbonds

# X-Wire™ - No Capillary Build Up

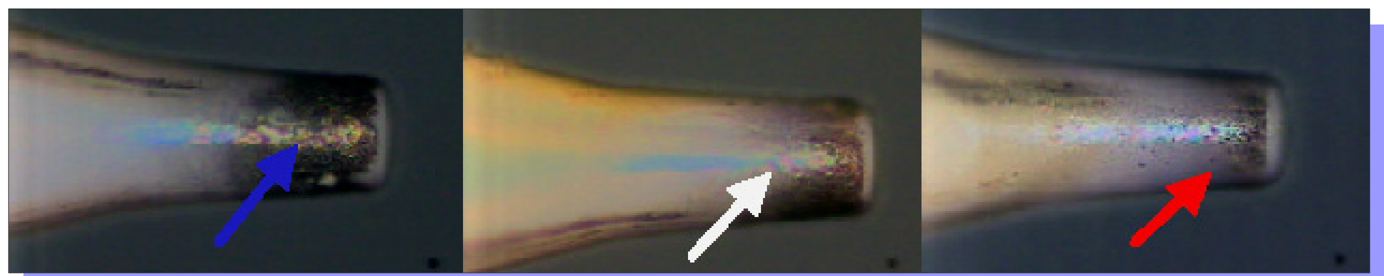
X-Wire™

Capillary Inspected After




Negligible Build Up in Capillary Wall Observed

Side View of the 1,000,000 Bonds. Capillary Viewed from Different Angles



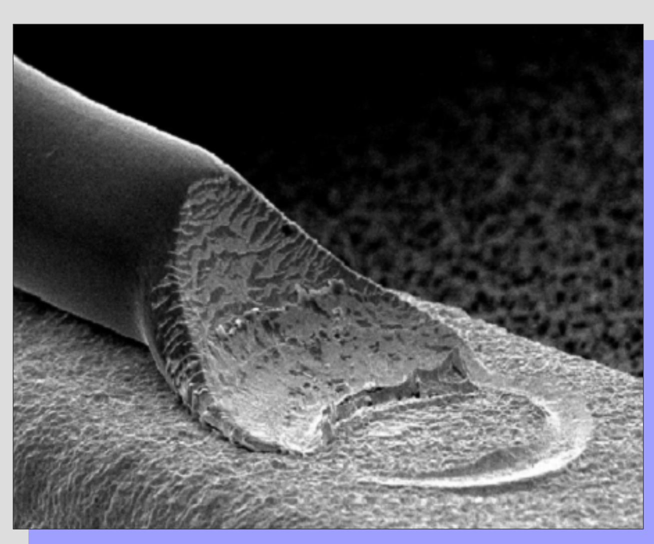

Copyright ©. All Rights Reserved

# X-Wire™ Ball Bond Summary

- Small Ball Pitch Capability
- High Ball Shear Strength
  - Comparable to Bare Wire
- Long Capillary Life

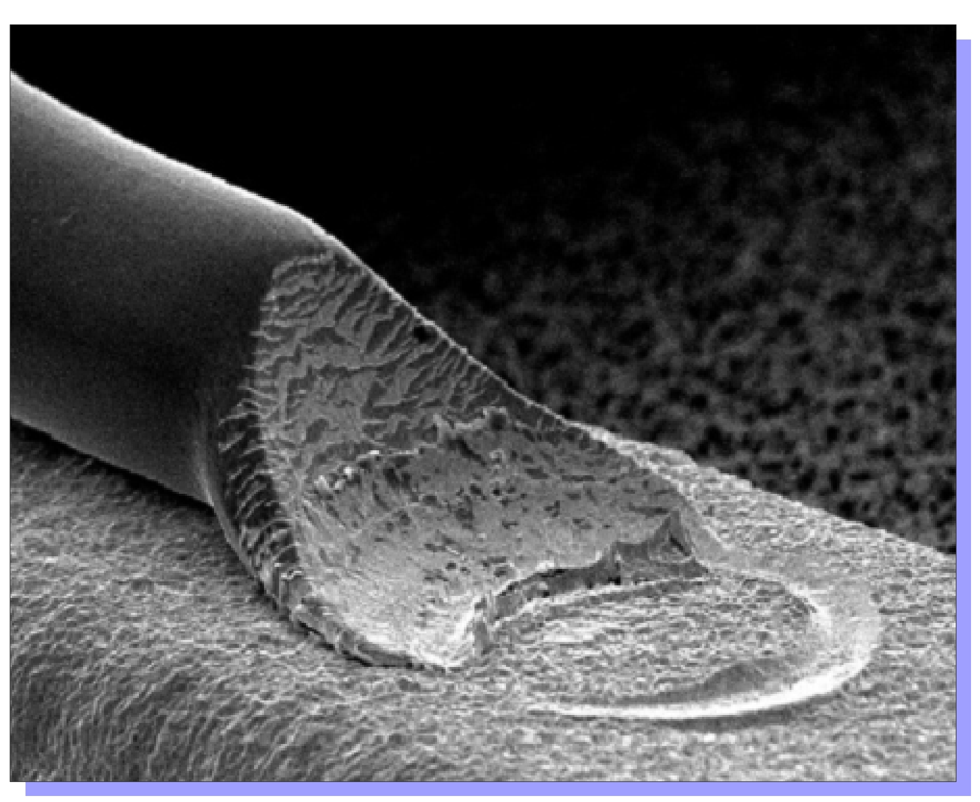

Copyright ©. All Rights Reserved

# X-Wire™ Stitch Bond Data



# X-Wire™ Stitch Bond

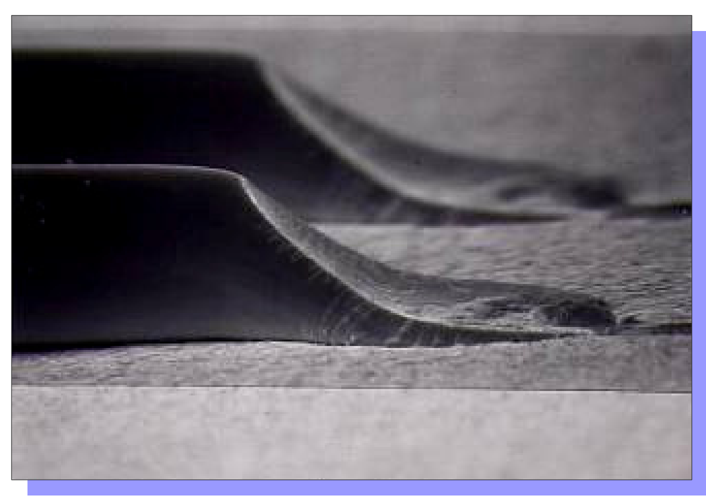


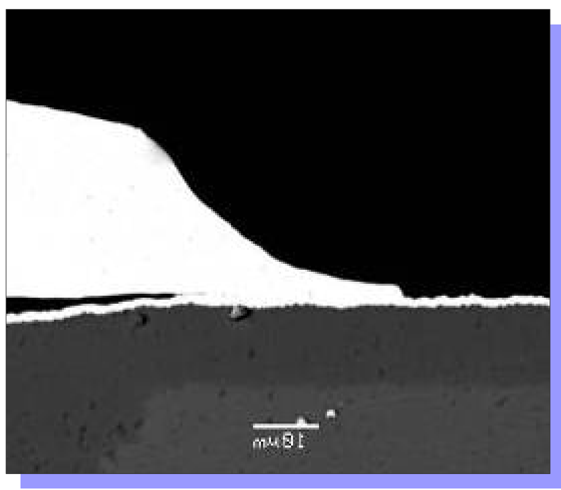


- Bond Through Coating
- Use Standard Wire Bonder
- Use Standard Capillary
- Good Pull Strength
- Laminate Substrate
- Leadframe Substrate


Copyright ©. All Rights Reserved

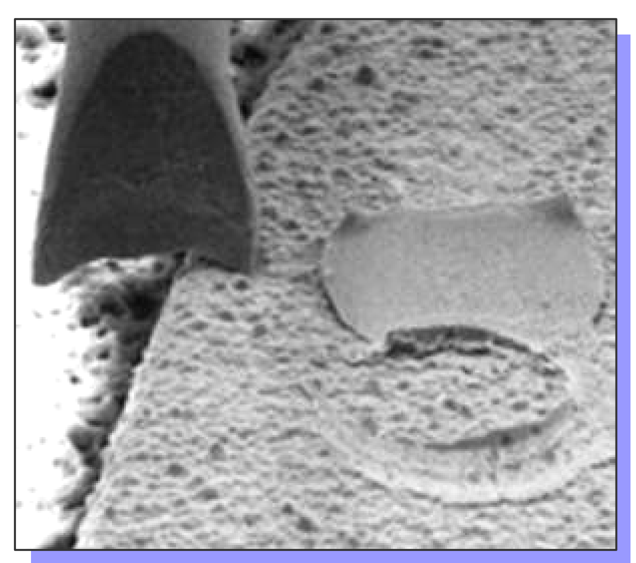
# X-Wire™ Stitch Bond
# Standard Forward Bonding






Copyright ©. All Rights Reserved

# X-Wire™ Stitch Bond Remaining After Stitch Pull



Source: ASM Pacific Technology Ltd.


Copyright ©. All Rights Reserved

# X-Wire™ Pull Strength Data

Pull Strength Data

7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

Pull Strength (g)

20 µm

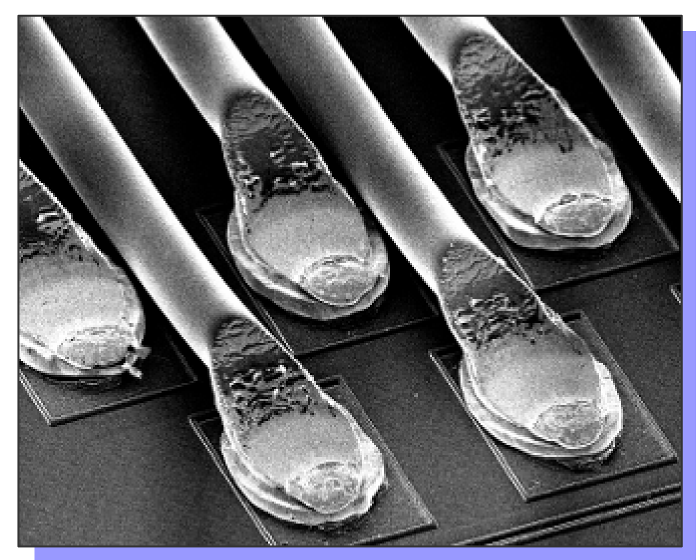
Min
Avg
Max

20 µm
23 µm
25 µm

Diameter Size


Copyright ©. All Rights Reserved

# X-Wire™ Reverse Stand-Off Stitch Bonding



Copyright ©. All Rights Reserved

# Stitch Bond Summary

- Bond Through Coating
- Good Pull Strength
- Laminate & Leadframe Capability
- Reverse Stitch Bonding (RSSB) Capability

May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# X-Wire™ Evaluation by ASM Pacific using Eagle 60 Wirebonder

| | X-Wire™ (20 µm) | X-Wire™ (25 µm) |
|---|---|---|
| 1st Bond Geometry | | |
| Bond Pad Pitch | 50 | 65 |
| Ball Diameter (µm) | 39 | 53 |
| Ball Height (µm) | 10 | 12 |
| 1st Bond Strengths | | |
| Shear Force (g) | 12.0 | 23.2 |
| Shear Strength (g/mil$^2$) | 6.5 | 6.9 |
| 2nd Bond Strengths | | |
| Stitch Pull (g) | 4.4 | 8.5 |

May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# X-Wire™ Reliability Data

# REL Data Summary

- **MSL Level 3: Pre-Conditioning**
  - Condition: 30°C, 85 % RH, 192 hrs
- **Biased HAST**
  - Condition: 130°C, 85 % RH, 4 V, 100 hrs
- **High Temperature Storage**
  - Condition: 150°C, 1000 hrs
- **Thermal Cycling**
  - Condition: -55°C to 125°C, 1000 cycles

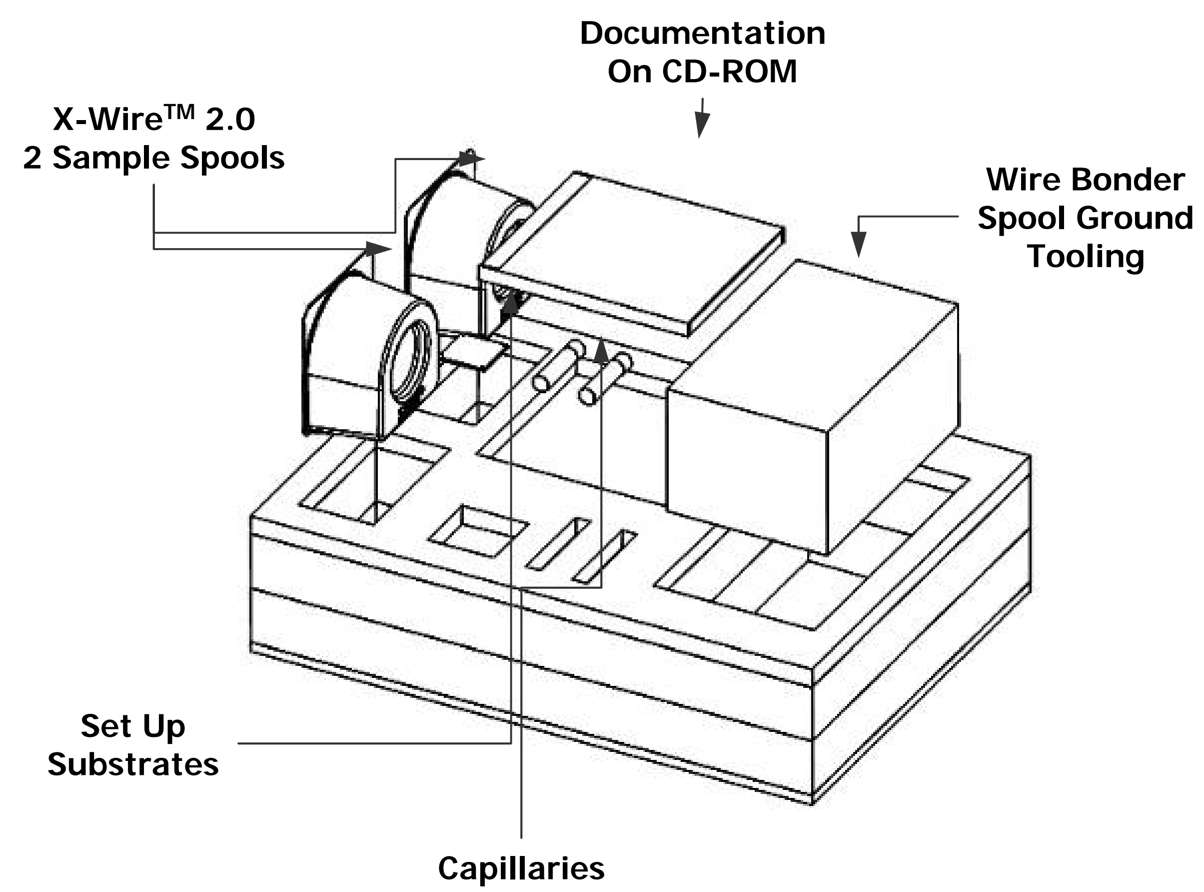
May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# X-Wire™ 2.0 Head Start Kit

Microbonds

# X-Wire™ 2.0 Head Start Kit Content







Copyright ©. All Rights Reserved

# X-Wire™ 2.0 Head Start Kit Features

- Allows Customer to Perform Internal Feasibility & Bondability Testing
- Includes Materials on Current Best Known Methods and Recommendations for Process Setup & Optimization
- ASM and K&S Bonder Platforms Supported
- Includes Choice of Wire Diameters
  - 25 µm, 23 µm, 20 µm Diameter X-Wires™ 2.0


Copyright ©. All Rights Reserved

# X-Wire™

# Microbonds

## X-Wire™ 2.0

**Welcome**
To X-Wire™ 2.0
Head Start Kit
Technical Documentation


## Chapter 1

- **1.1** X-Wire(TM) 2.0 Product Bulletin - Overview & Roadmap
- **1.2** X-Wire(TM) 2.0 Technical Data Sheet
- **1.3** X-Wire(TM) 2.0 Handling & Storage Requirements
- **1.4** Required Wire Bonder Modification Procedures
  - **1.4.1 ASM** Wire Bonder Modification Procedure
  - **1.4.2 K&S** Wire Bonder Modification Procedure
- **1.5** Wire Clamp Pads Replacement Instructions

## Chapter 2

- **2.1** Capillary Selection Guidelines for X-Wire(TM) 2.0
- **2.2** X-Wire(TM) 2.0 Wire Bonding Process Optimization
  - **2.2.1 ASM** Bond Parameters Optimization
  - **2.2.2 K&S** Bond Parameters Optimization

## Chapter 3

- **3.1** Design Rules - X-Wire(TM) 2.0 Wire Bond Layouts

## Chapter 4

- **4.1** Plasma Treatment of X-Wire(TM) 2.0 Bonded Device

## Appendix

- Getting Started
- Image Gallery
- References & Acknowledgments

All Documents in Adobe Acrobat Format (PDF)
"Get Adobe Reader"



Copyright © 2006 Microbonds Inc. All Rights Reserved.

May 2006: Strictly Confidential
Copyright ©. All Rights Reserved

# X-Wire™ 2.0 Head Start Kit Availability & Ordering Information

- To Order Please Contact


**Tanaka Asia**

**Mr. Frank Tanaka**

K-TANAKA@ml.tanaka.co.jp
T: + 81-3-6311-5588

**Mr. Takeshi Inaba**
T-INABA@ml.tanaka.co.jp
T: + 81-3-6311-5588

**Microbonds Inc.**

**Mr. William (Bud) Crockett**

bcrockett@microbonds.com
T: +1 408-504-4971



Copyright ©. All Rights Reserved