Effective Method for Wire Bonds Rework using Conductive Epoxy

C. Marsan-Loyer, T. Dequivre
MiQro Innovation Collaborative Centre, 45 boul. de l’Aéroport, Bromont, Quebec, Canada

Introduction
New design and product development requires time, money and effort. Packaging is often the last step before the prototype can be tested. Without rework, the invested resources in the design and manufacture of failed assemblies are lost.

Problematic
Untestable designs due to prototypes wire bond defects:
• Damaged traces/pads
• Insufficient or lack of bonding metallurgy
• Surface contamination

Solution
Effectively reattached wire bonds that are mechanically and electrically comparable to non-failed wires.

Rework method
Simulation of failed wire bonds
• Wires are sheared at the stitch bond

Rework manipulation steps
• Extremity of debonded wire manually positioned on bonding pad
• Drop of conductive epoxy deposited on wire
• Nitrogen oven bake to cure epoxy

Characterization
Wire pull
• All wires pulled into BL wire interval (10-15g)
• No rupture at wire/epoxy interface

<table>
<thead>
<tr>
<th></th>
<th>Gold</th>
<th>Epoxy 1</th>
<th>Epoxy 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean value (g)</td>
<td>12.1</td>
<td>12.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Standard deviation (g)</td>
<td>0.2</td>
<td>0.5</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Epoxy 2 manipulation during rework
• Harder to manipulate
• Does not easily wet both the pad and the wire
• Additional handling and/or epoxy volume often necessary
• Higher risks of shorting a neighbor wire

Cross-section observations
• Larger silver flakes in epoxy 2 decrease the surface interface between gold and silver
• Good continuous connection from wire to pad with epoxy 1
• Epoxy 1 drop shape is smooth and compliant

Experiment
Two test samples
• 120 wire bonds on gold pads
• 2 groups of 40 wires sheared at stitch bond
• 1 group of 40 wires as reference

<table>
<thead>
<tr>
<th></th>
<th>Au Wire</th>
<th>Epoxy 1</th>
<th>Epoxy 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball bond diameter (µm)</td>
<td>45</td>
<td>45-55</td>
<td>55-65</td>
</tr>
<tr>
<td>Wire length (µm)</td>
<td>550</td>
<td>550</td>
<td>550</td>
</tr>
<tr>
<td>Wire height (µm)</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Break Load (g)</td>
<td>10-15</td>
<td>10-15</td>
<td>10-15</td>
</tr>
</tbody>
</table>

Viscosity (cP)
• Epoxy 1: 50-60cP
• Epoxy 2: 60-70cP

Silver flakes dimensions (µm)
• Epoxy 1: 5-10µm
• Epoxy 2: 10-15µm

Volume resistivity (ohms-cm)
• Epoxy 1: <0.0005
• Epoxy 2: <0.0009

Electrical characterization
• Resistance measured on two-probes station
• Reference gold-only wires compared to reworked wires

Mechanical characterization
• Wire pull on 30 wires/group
• X-section on reworked area to assess integrity of the reworked connection

Electrical results
Group 1 (Epoxy 1)
• Stable connection
• No significant resistance increase compared to gold-only connection

Group 2 (Epoxy 2)
• Unstable connection (std=78 mΩ)
• Significant increase of resistance compared to gold-only connections

Conclusion & Perspectives
Wire bond rework is:
• Saving otherwise failed unusable prototypes
• Providing a mechanically and electrically good connection
• Robust and reproducible
• Possible through commercially available conductive epoxies
• A quick manual process, easy to put in place

Wire bond rework is essential to any development process to salvage the few first good parts that help to make the go/no-go decision on the process or product.

Failed assembly = 100% resources loss