Introduction

Tin (Sn) coatings have been used for years by terminal and connector manufacturers to maintain a stable separable contact interface over the life of the connector. The issue has been that most electrical and electronic connectors were made from copper (Cu) based alloys for their electrical conductivity, however, copper when coupled with tin will naturally diffuse. Figure 1 illustrates this phenomenon over time.

The Sn plating is quite soft and allows for a mating contact to break through the thin surface oxide at reasonably low loads providing a good electrical path between two mating parts. (The oxide is depicted in Figure 1 as the solid dark area.) Should the layer under the oxide become harder through the formation of Cu-Sn IMC, much higher loads will be required to break through this surface oxide to achieve an acceptable electrical path. Figure 1 shows the presence of elemental Sn below the surface oxide after prolonged exposure to elevated temperature with a system protected by the Olin Brass Advanced Tin™ Barrier.

How Olin Brass Advanced Tin™ Barrier Works

Plating tin directly onto a copper substrate allows for an essentially infinite supply of elemental copper readily able to diffuse into the tin. Olin Brass Advanced Tin™ Barrier was developed to slow the diffusion of copper as much as kinetics will allow. The barrier consists of nickel and copper with the finite amount of copper in the barrier acting sacrificially to alloy with the tin which in turn creates a more effective barrier to diffusion than just nickel alone. Figure 2 illustrates that as the temperature increases, the rate at which intermetallic thickness grows is quicker without the use of Olin Brass Advanced Tin™ Barrier. Even a typical Nickel (Ni) underlayer, such as 50µin (1.2µm) Ni barrier will force the specification of thick tins to ensure adequate amount of initially plated Sn required for good contact stability. Olin Brass Advanced Tin™ Barrier shows exceptional ability to slow diffusion at temperatures up to and including 150°C.

Insertion Force Benefit & Electrical Performance

Inhibiting this IMC formation has allowed terminal design engineers to utilize thinner tin plating thicknesses while maintaining good electrical performance. Thinner tin platings provide for lower resistance to normal forces and similarly coefficient of friction. In this regard terminal manufacturers supporting US and Japanese OEM’s have successfully pushed the use of reflow tin thicknesses down to below 40 µin (1µm) realizing significant reductions in insertion efforts on multi-way terminal systems.

Figure 3 clearly illustrates this trend. Utilizing the rough topography of Matte Tin and thickness expected to have good electrical performance a very high R/N value is realized. Insertion force relief can be found in moving to thinner tin but as thickness decreases it becomes important to utilize Olin Brass Advanced Tin™ Barrier (ATB) to ensure low stable contact resistance.
Olin Brass Advanced Tin™ Barrier was conceived through surveying the needs of automotive and electronic terminal designers and based on sound metallurgical science. This barrier system is unlike any other and inhibits the diffusion of copper into tin platings better than other commercially available barrier systems. Olin Brass' diffusion barrier extends the possibility of using Electro-Tin Reflow and other tin plating systems at Class IV (150°C) automotive service environments.

For more information contact Olin Brass at 618-258-5255, Olinbrass.com or email us at techinfo@olinbrass.com.

How Is It Specified

The thickness of Olin Brass Advanced Tin™ Barrier is 10-40 µin or 0.25-1.0 µm, and can be specified under any electro-plated product. However, the use of Reflow Tin is highly recommended to optimize the benefits provided by this plating system. Table 1 contains the minimum recommended guidelines for tin thickness over Olin Brass Advanced Tin™ Barrier in different service environments. Detailed discussion with Olin Brass Market Development Engineering is highly recommended to best optimize the plating system for your application.

<table>
<thead>
<tr>
<th>Service Environment</th>
<th>Plating System</th>
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<tbody>
<tr>
<td>125°C / 1000 Hours</td>
<td>20 µin Sn</td>
</tr>
<tr>
<td>125°C / 3000 Hours</td>
<td>35 µin Sn</td>
</tr>
<tr>
<td>150°C / 1000 Hours</td>
<td>40 µin Sn</td>
</tr>
<tr>
<td>150°C / 3000 Hours</td>
<td>55 µin Sn</td>
</tr>
</tbody>
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Table 1. Minimum tin thickness when coupled with Olin Brass Advanced Tin™ Barrier at given service environment and time.

Availability

As a global leader in the supply of material systems solutions to the ever expanding world, we strive to ensure the tools are within reach of customer local design and manufacturing centers. Contact Olin Brass in the USA, Wilms in Europe, Olin Asia Pacific in China and SE Asia, and Dowa Metals in Japan. This plating solution is also available on copper alloy wire from Fisk Alloy Wire and Sumco Inc. on post plated bandolier pins. If you have any difficulty obtaining the technical or supply chain information necessary; or would like to review your application in more detail with an Olin Engineer, please contact Olin Brass Market Development Engineering for further assistance.