焊料合金如锡银铜合金和锡铜合金的熔点分别为摄氏218度和227度，比锡铅合金的熔点高大约摄氏35度。锡铅合金的回流温度通常为摄氏220度-225度，公称“过热”温度为大约摄氏40度。现在，正在努力推动降低无铅合金回流焊接的过热。使用惰性氮气可改进无铅焊料的熔湿并降低所需的过热。如图1和图2所示，惰性氮气可降低所需过热至少摄氏20度。惰性氮气还可以减少焊料的焊渣和空隙。

Nitrogen's Effect on Pb-free Soldering

Paul Stratton

Inert atmospheres lower superheat profiles and improve wetting.

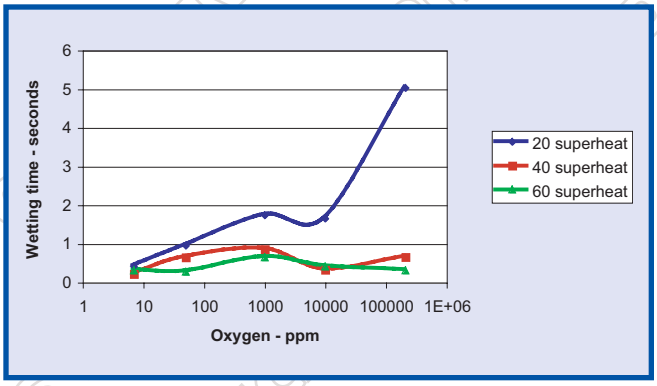

FIGURE 1: The effect of inerting on wetting times for Sn3.8Ag0.7Cu.

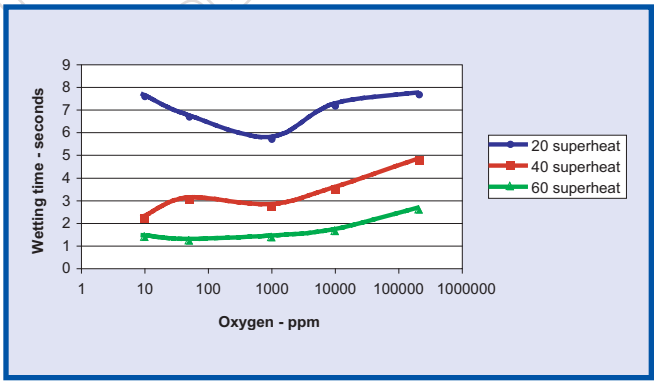

FIGURE 2: The effect of inerting on wetting times for Sn0.7Cu.

Lead-free alloys such as SnAgCu (SAC) and SnCu have melting points of 218° and 227°C, respectively, about 35°C higher than SnPb eutectic. Reflow temperatures for SnPb are commonly 220° to 225°C with a nominal "superheat" of around 40°C.

This superheat is part of the process window for reflow, taking into account different heating rates at different joint locations on a particular board. Similarly, the pot superheat current for wave soldering with eutectic SnPb is even higher, around 40° to 50°C. However, when lead-free solders are used, reflow temperatures above 260°C are implied for the same superheat. These temperatures are outside the ratings of many available components and boards. Longford said at the IPC and JEDEC International Conference on Lead-Free Electronic Components and Assemblies that lead-free solder processes typically reduce moisture sensitivity levels by two, with the failure modes being warpage and delamination.[1] In addition, the National Physical Laboratory reports increased board aging with SAC soldering, leading to lower yields for second-pass soldering with HASL, OSP and immersion Ag board finishes.[2]

There is thus a strong drive to reduce the superheat for reflow when lead-free

soldering is adopted. The resulting narrowed process window may have adverse effects on process yields, particularly for high-volume consumer products. Work commissioned by BOC at the NPL has shown that the use of nitrogen inerting can improve wetting in lead-free solders and reduce the superheat needed.[3] The effect of inerting on the wetting of SAC – the alloy of choice for reflow soldering – is shown in **Figures 1** and **2.** Clearly, nitrogen inerting can reduce the superheat required by at least 20°C.

Similar considerations apply to wave soldering (**Figure 2**), where Sn/0.7Cu is a lower cost alternative to SAC, although the situation may not be as severe. For wave soldering, drossing losses will be more expensive since the value of lead-free solders are at least twice that of current SnPb solders. The little data that have been published on the drossing of Sn0.7Cu suggest that drossing is slightly lower than for SnPb and that nitrogen inerting has the same sort of impact on drossing, reducing it by 85% or more.[4]

It is also known that SAC reflow soldering increases the tendency to form voids. This effect is particularly severe if a SAC paste is used with components with leaded terminations, as may be the case until all components become lead-free.[5] The use of nitrogen inerting reduces this effect considerably, probably by protecting the flux at the higher reflow temperature and permitting it to reduce the oxides in the short time available above the liquidus. ■

References

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