Flux Splattering during the Reflow

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1. Preface

In reflow soldering, solder paste is frequently used, and flux splattering may occur. A certain amount of gas is generated when the flux constituents in the solder paste decompose or evaporate. The gas escaping the molten solder causes flux splattering (Fig. 1).

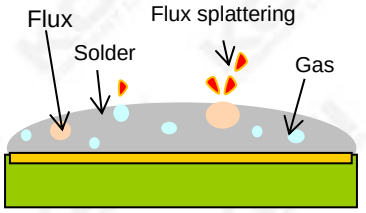

Fig. 1 Mechanism of Flux Splattering

Splattered flux could cause a contact error if it is on a contact point of a connector, or a brightness error or recognition error if it is on an LED, lens or sensor module, etc. Some customers apply protective tape over the components to prevent flux splattering. To reduce these quality issues and extra process steps associated with flux splattering, a solder paste which would not cause flux splattering is needed.

In this article, we will discuss the timing of flux splattering occurrence, relationship between the reflow profile and flux splattering occurrence, and introduce a new product which is intended to prevent flux splattering.

2. Splattering Evaluation Method

A reflow simulator was used to monitor flux splattering and confirm the timing and volume of flux splattering.

The solder paste was printed on a copper plate and spacers were used to place a glass plate over the solder paste (Fig. 2) so that the timing and the volume of the flux splattering could be observed.

Place a glass plate on spacers. Count the number of the flux splatters on the glass plate.

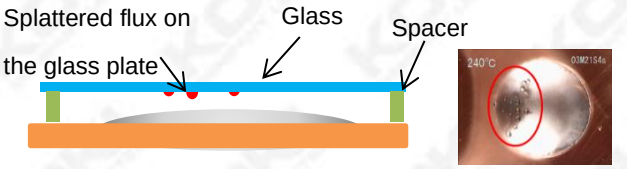

Fig. 2 Evaluating flux splattering

3. The Timing of Flux Splattering Occurrence

Based on the evaluation, we confirmed that the flux splattering does not occur during the preheat (Fig. 3). Although the solvent in the flux is evaporating during the preheat, the gas has escaped between the solder powder in the paste. Consequently, flux splattering is prevented. On the other hand, the highest amount of flux splattering was observed immediately after the solder is molten. At the melting point, solder powders are fused along with a large amount of flux. The flux blended in the molten solder will be evaporated and dispersed out of the solder, which causes the flux to splatter.

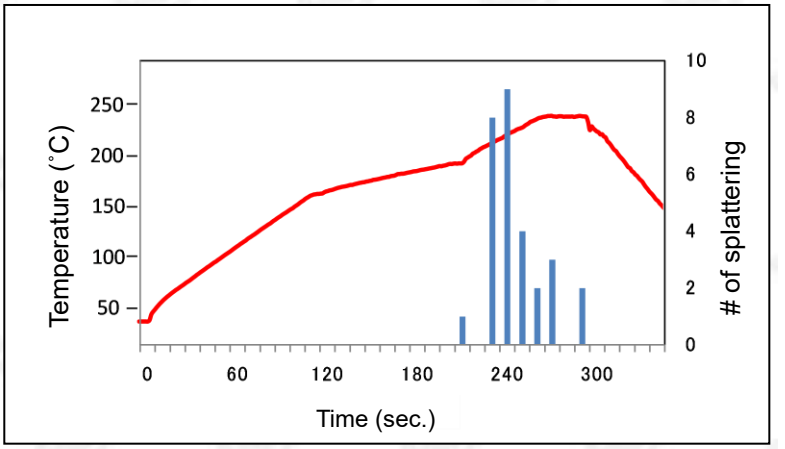

Fig. 3 Timing of the splattering occurrence

4. Relationship between the Reflow Profile and Flux Splattering

We compared flux splattering occurrence by changing the preheat condition of the reflow profile (Fig. 4). Based on the comparison, it is confirmed that the lower the preheat temperature is, the more flux splattering occurs. It is assumed that low preheat temperature slows down the solvent evaporation. As a result, more solvents are contained in the molten solder which evaporate and promotes higher flux splattering occurrence at the beginning of the reflow stage. This is confirmed by reduced flux splattering occurrence with higher preheat temperature.

A possible countermeasure for flux splattering is to promote the evaporation of the volatile content, such as solvents, during the preheat stage so that the amount of volatile content at the reflow stage can be reduced. However, it should be noted that by raising the preheat temperature, activators in the flux will be deteriorated and solder powder and component electrodes may be re-oxidized, which cause meltability issues.

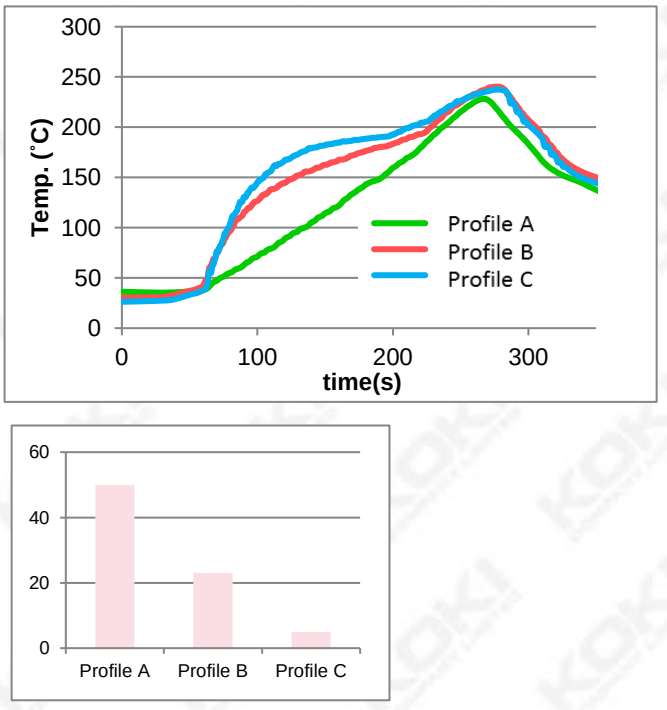

Fig. 4 Reflow profile compared with the number of splattered flux

5. Flux Composition and Flux Splattering

Although flux splattering can be reduced to some degree by modifying the reflow profile, it is more of a burden for a customer with multiple reflow soldering lines. In addition, as previously mentioned, using higher preheat temperature would deteriorate the component electrodes and the solder paste and may cause the PCB or the package to warp. Therefore, development of a solder paste which can prevent flux splattering with a low preheat temperature reflow profile is needed.

Based on the previous evaluation, a large amount of volatile content during solder melting caused flux splattering. Resin content, such as rosin, and additives can be designed not to evaporate during the reflow stage. However, increasing the volatility of the solvents, which contain high volatile content, is difficult as high volatility causes the solvent to evaporate even at room temperature, which dries up the solder paste and increases the viscosity. KOKI focused on the behavior of the flux residue and successfully reduced flux splattering using the following mechanism.

6. Capping Effect of the Flux

We discussed previously that inhibiting the gas from being generated at the reflow stage to prevent flux splattering has many drawbacks. KOKI's newly developed lead-free solder paste S3X58-HF912 is expected to help solve this issue with a new method to prevent flux splattering, namely, a capping effect. With this solder paste, even if the gas is generated at the reflow stage, a viscous flux layer on the surface of the molten solder helps so that the released gas would not cause flux splattering (Fig. 5).

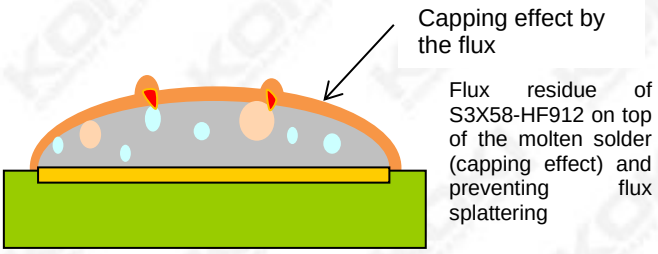

Fig. 5 Capping Effect of the HF912 Flux

7. Flux Splattering Performance of S3X58-HF912

By using S3X58-HF912, flux splattering is reduced even with a low-preheat temperature reflow profile, compared to conventional solder pastes, as seen in Fig. 6. This allows low flux splattering reflow soldering with wide range of reflow processing conditions. Other

surface mount process characteristics, such as printability and meltability, are similar to those of a general-purpose solder paste. Therefore, it can be stated that this solder paste is useful in reflow soldering a sensor or a camera module, the components which are increasing in their application.

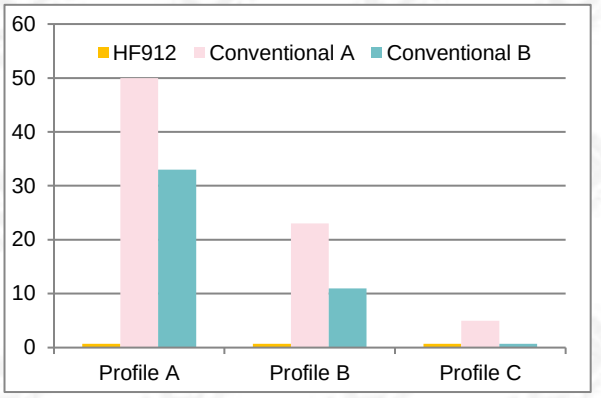

Fig. 6 Comparison of Flux Splattering Occurrence

8. Conclusions

In this article, we discussed the mechanism of flux splattering, how to reduce the flux splattering by modifying the reflow profile, and the development of a new solder paste with low flux splattering.

(1) Flux splattering frequently occurred immediately after the solder was molten.

(2) One way to reduce flux splattering is to increase the preheat temperature and reduce the volatile content at the reflow stage; however, other soldering performance, such as meltability, etc. could be deteriorated.

(3) KOKI's low flux splattering solder paste, S3X58-HF912 can help to reduce flux splattering without narrowing the process window thanks to the capping effect of the flux.