

Thermal Characteristic Evaluation of Lead-Free Solders

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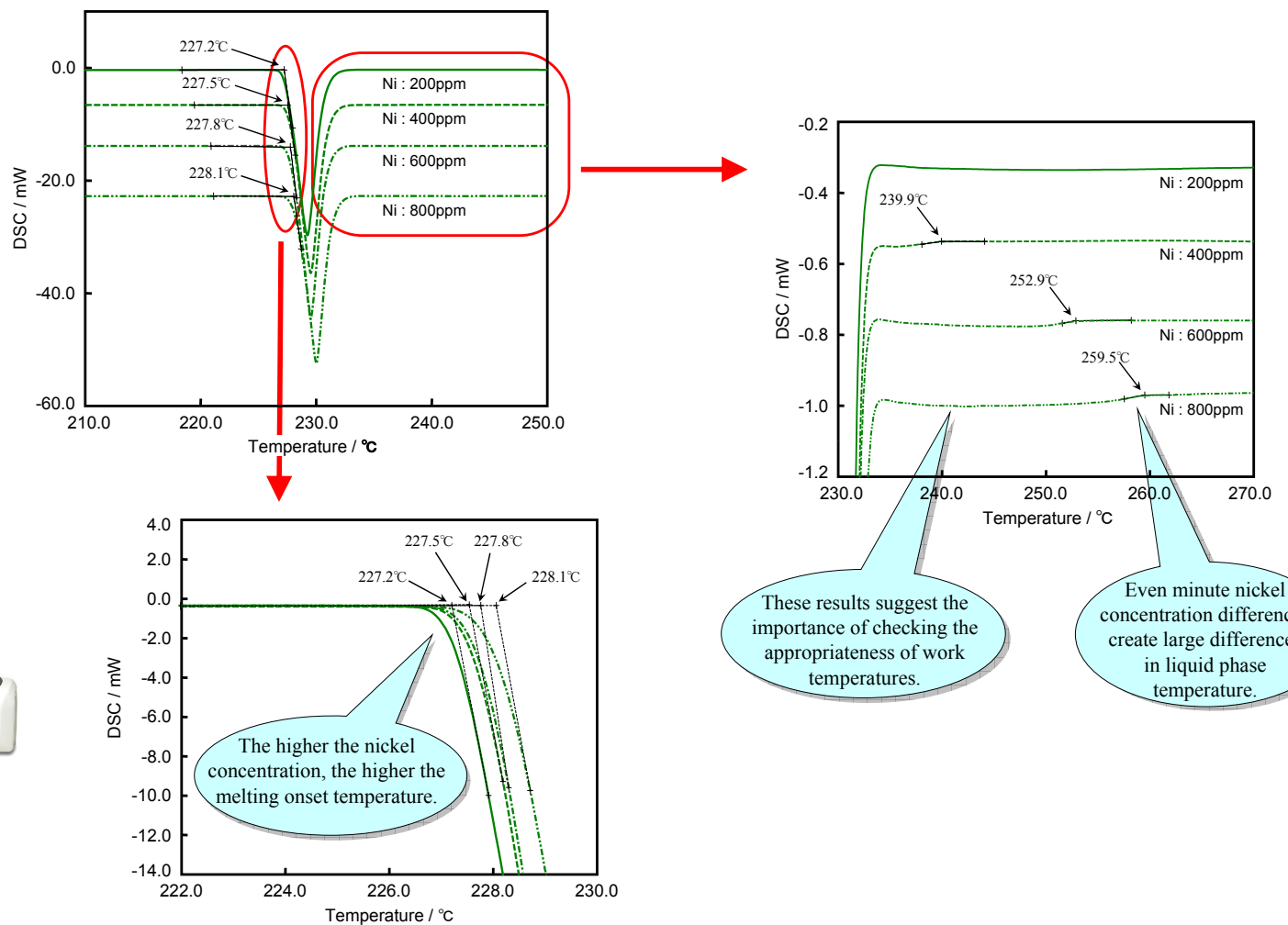
Introduction

The regulation of hazardous materials has been expanding on a global scale in recent years, from the E.U. RoHS directive to the Chinese version of RoHS. Of these regulations, lead-free surface mounting is now commercially viable. The switch from conventional Sn-Pb solder to lead free solder is progressing and various Sn-based eutectic alloys are being studied. One problem with lead-free solder is that its melting temperature is higher than the heat resistance of mounted parts. Furthermore, high temperature work accelerates the oxidation of solder and reduces joint strength and connectivity. While factors such as usability, mechanical characteristics, and cost are taken into account when determining solder composition, it is crucial to evaluate the effects of soldering temperature and oxidation reactions when considering work conditions.

Thermal characteristics of the several kinds of lead-free solders are measured by DSC and TG/DTA. The results of DSC showed a difference of the liquid phase temperature by the slight nickel composition. The results of TG/DTA showed the controlling of the oxidation of solder by addition of phosphorus.

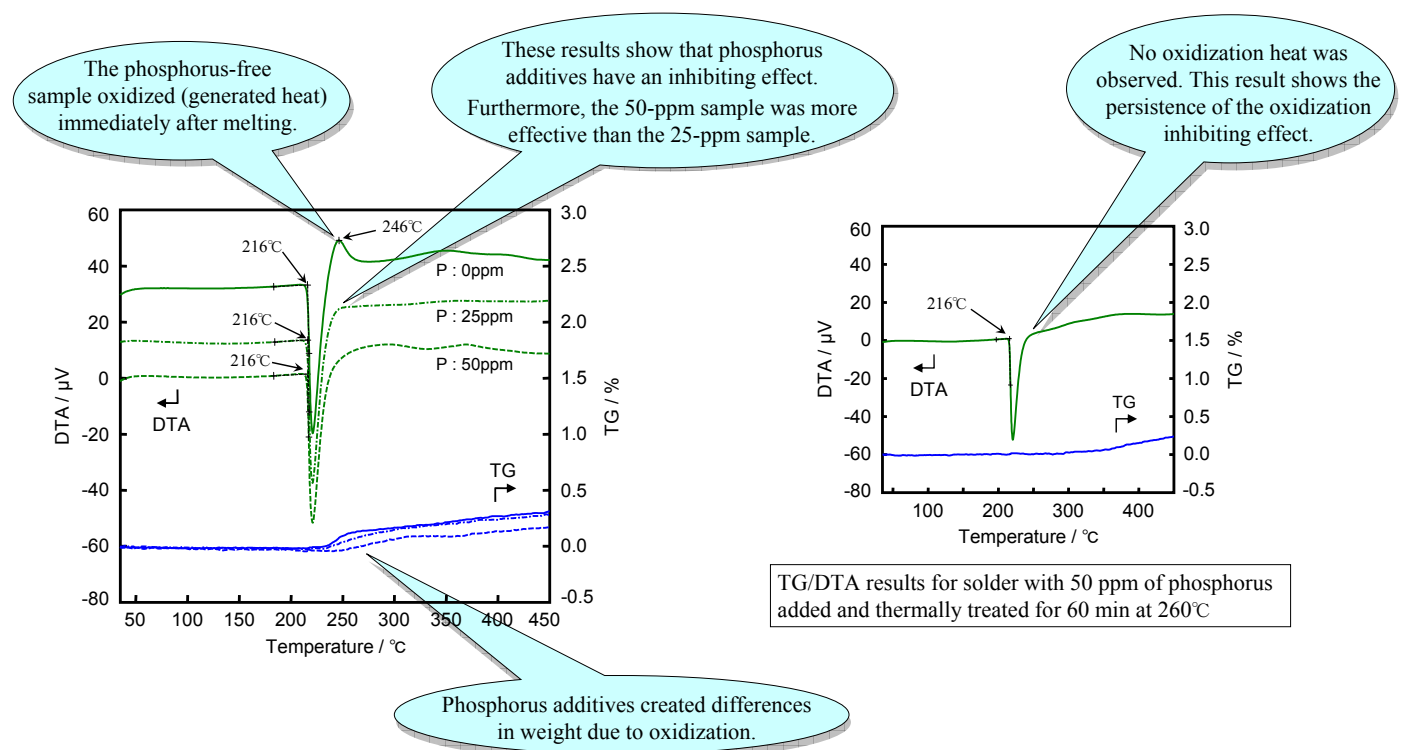
Experiment - 1

Sample 1:
Sn-0.6Cu-Ni lead-free solder
Ni amounts: 200,400,600 and 800 ppm
Instrument :
DSC7020 (SII NanoTechnology Inc.)
Measurement Condition :
Sample weight : 7mg
Temperature range : 160 to 300°C
Heating rate : 10°C/min
Atmosphere : N₂



Experiment - 2

Sample 1:
Sn-3Ag-0.5Cu lead-free solder
Phosphorus amounts: 0, 25 and 50 ppm
Instrument :
TG/DTA7200 (SII NanoTechnology Inc.)
Measurement Condition :
Sample weight : 10mg
Temperature range : R.T. to 450°C
Heating rate : 20°C/min
Atmosphere : Air



Conclusion

In this study, the effects of solder composition on work temperature and oxidative stability were evaluated using DSC and TG/DTA. The DSC results detected minute temperature differences caused by composition ratio with high sensitivity and the TG/DTA results showed the effects of oxidation suppressing additives. These results show that DSC and TG/DTA are effective in evaluating the thermal characteristics of lead-free solder.