

## (N)ow (Y)ou (K)now

### Knowledge Sharing

The (N)ow (Y)ou (K)now, aka **NYK**, series is written to help spread the collective knowledge that has been accumulating on subjects that today's process engineers need to know.

## Using Formic Acid for Better Reflow

### Abstract

Solder reflow has become an important part of the assembly of microelectronic devices. A good solder interface between components is essential for the transference of electrical signals and/or heat from the device. As power levels go up in devices so does the heat that needs to be dissipated. A good path to remove this heat is impacted by the voids and non-wetting of the Thermal Interface Material (TIM). One of the contributing factors to non-wetting is an oxide barrier layer between the TIM and the mating surfaces. The use of Formic Acid has been found to be very effective at reducing the oxide barrier layers and allowing for better wetting and fewer voids.

### Problem

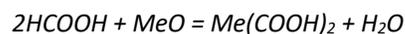
The joining of two materials using a "filler" material can be inhibited by barrier layers of oxides that can form on all of the mating surfaces. The careful storage and handling of materials will reduce, but not eliminate, the formation of oxides on surfaces. Even if the oxides are "cleaned" from the materials, additional oxides will form at reflow temperatures as oxygen out gasses from the materials and into the chamber.

Oxides must be removed, or at least broken, to allow wetting of the filler material to the base layers of mating surfaces.

### How does it work?

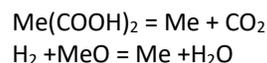
A formic acid atmosphere will break the chemical bond of oxides from the base materials at elevated temperatures. The formic acid will also inhibit the formation of additional oxides at reflow temperatures.

Formic acid reaction on metal oxides (Me=metal) at >150°C:



Between 150°C - 200°C the formic acid breaks the oxides bond and the oxides form a carboxyl compound.

With further processing at >200°C:



Above 200°C the oxides further break down into carbon dioxide, hydrogen and water which can be evacuated from the atmosphere.

## What is the process?

The process of using formic acid needs to have to be done in a low oxygen environment. Using an ATV SRO series furnace you would first program in at least two (2) purging stages. By using a combination of vacuum and nitrogen purges the atmosphere should be approximately  $< 2\text{ppm}$  of oxygen.

The next stage should be to raise the temperature to approximately  $150^{\circ}\text{C}$ . At this point you can turn on the nitrogen/formic acid flow, the mixture should be about 2-3% formic acid. Allow the formic acid to dwell and start breaking the oxides. You should then increase to temperature to  $200^{\circ}\text{C}$ , or above to start degrading the oxide compounds. Again, allow this to dwell.

After the  $200^{\circ}\text{C}$  dwell, raise the temperature to the appropriate reflow temperature for the solder alloy that you are using. Part way into the reflow you should shutoff the formic and either flow nitrogen or turn on the vacuum, using a chemical resistant vacuum pump. You can then continue with your normal process of cool down.

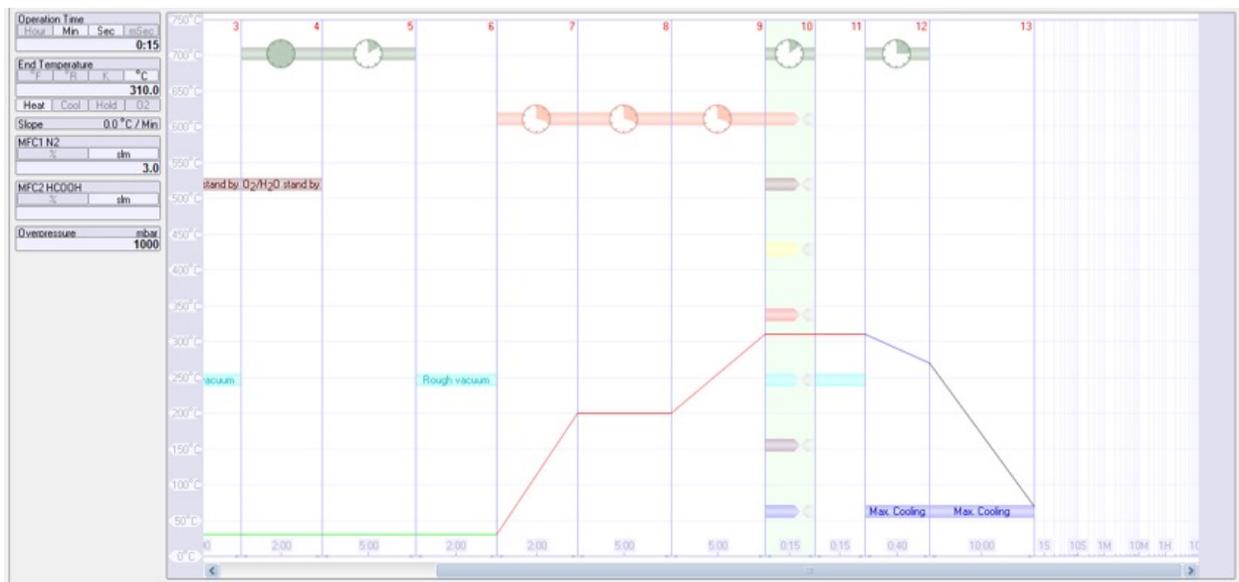


Figure 1 Formic Acid Reflow Example

## More Information

Contact [Sales@BSETPLASMAS.com](mailto:Sales@BSETPLASMAS.com)

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