

Heller Industries Advanced Oven Technology

--Fluxless Reflow--



Reflow in Formic Acid Vapor

- Fluxless reflow utilizes gas phase Formic Acid (HCOOH) to replace standard fluxing agents
- Eliminates the need for pre-reflow fluxing and post-reflow flux cleanup steps
- No post-reflow flux clean facilitates inline application of epoxy and inline epoxy curing solution
- Feasibility has been demonstrated with production grade oven
- Extensive engineering efforts in safe, precision delivery of formic acid and abatement.



Heller Industries

Fluxless Reflow Advantages

1. Can use any reflow profile (e.g., tent or soak profile) with formic acid
2. Can adjust formic acid profile in oven in conjunction with thermal reflow profile
3. Includes Formic acid safety system (i.e., sensors/detectors) adheres to industry standards
4. Includes Formic acid abatement systems for Green Process Solution
5. Includes real time formic acid concentration monitor system

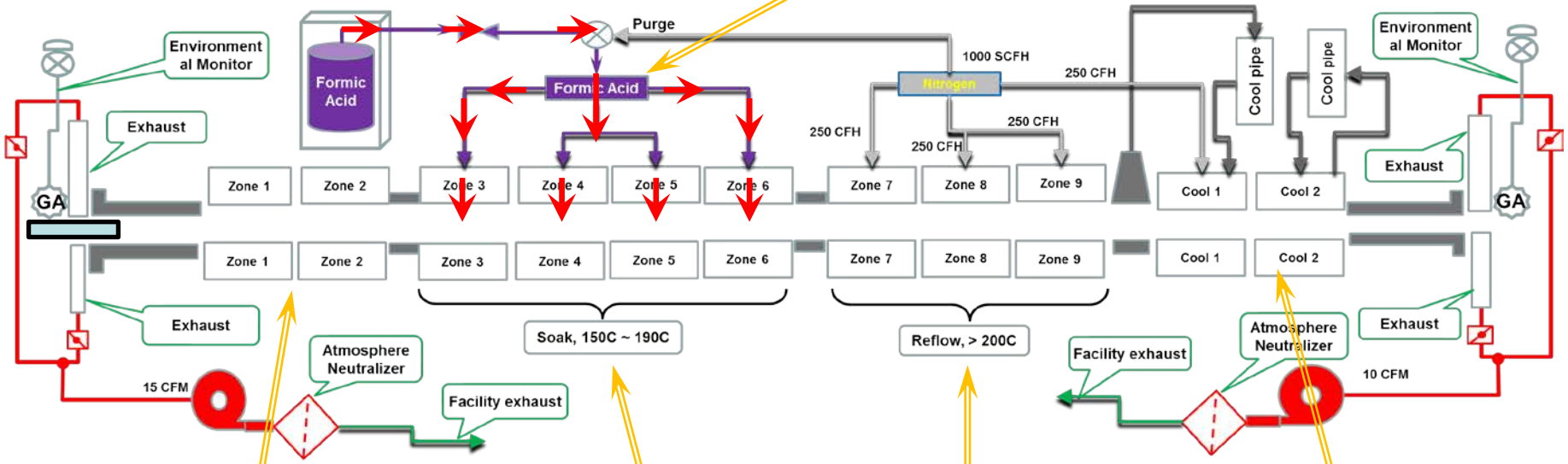


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Formic Acid Horizontal Reflow Oven

Formic acid vapor is introduced into the process chamber



Product enters the process chamber with inert atmosphere

Product is heated above the solder liquidous temperature

Product soaks in formic acid environment, the acid removes the oxidation layer

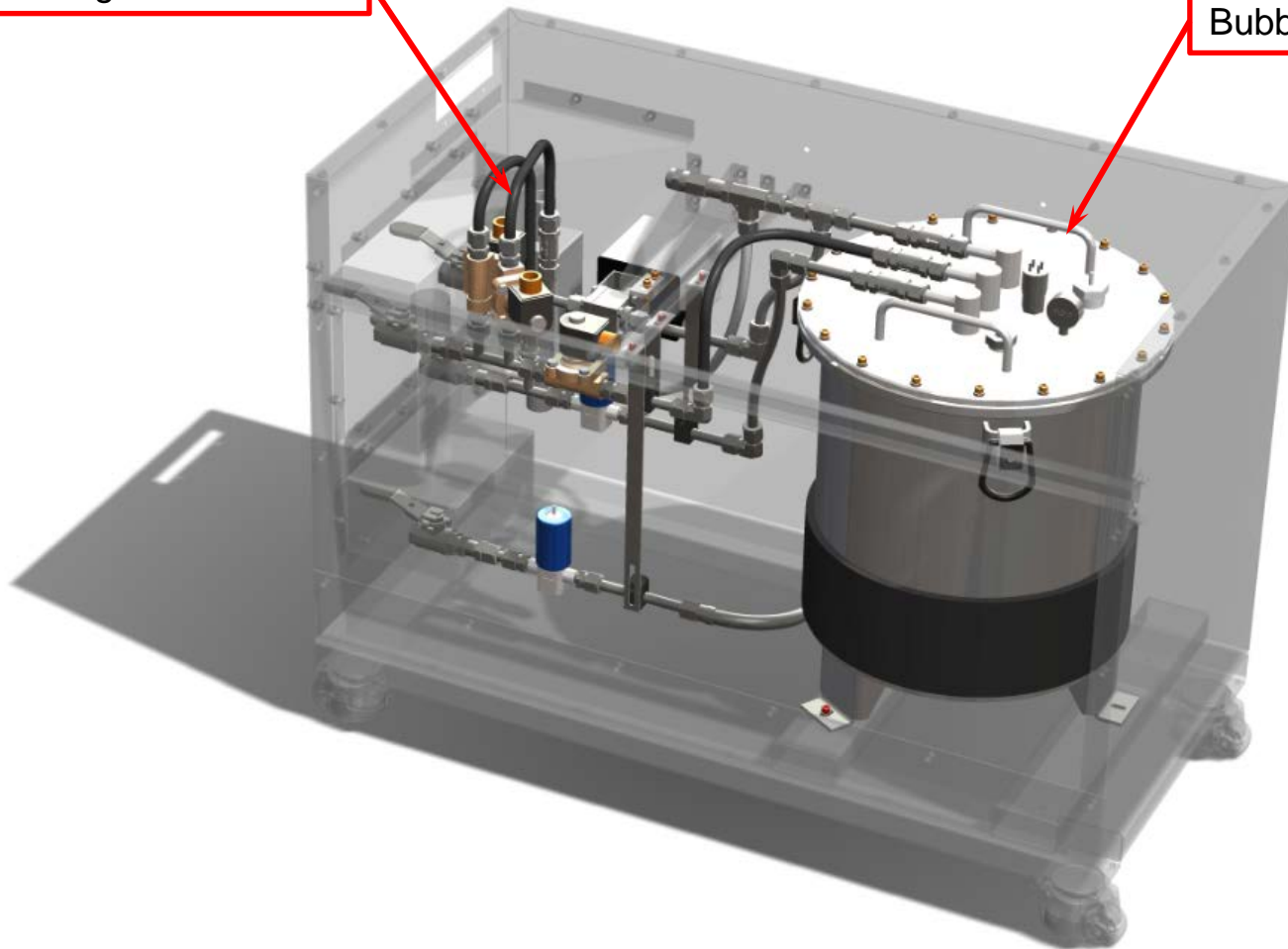
Product is cooled and exits the tool



Formic Acid Precision Bubbler Cabinet

Plumbing and control

Bubbler



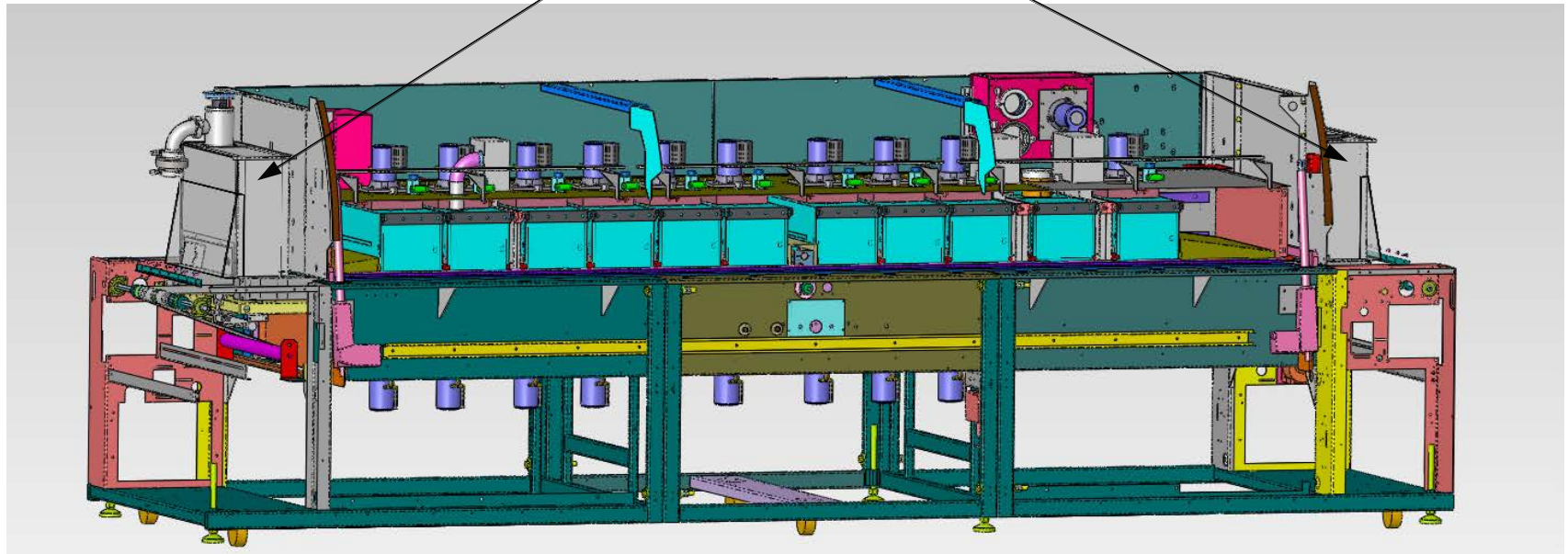
Formic Acid Precision Bubbler Design

- Bubbler designed to provide consistent, reliable formic acid vapor concentration
- Formic acid vapor concentration saturates nitrogen according to Antoine equation for a given temperature
- Formic acid vapor concentration in the oven can be varied by bubbler temperature and nitrogen flow through bubbler
- Bubble size is engineered with diffuser plates
- Minimum bubble path length sets the minimum level the bubbler can operate
- Auto refill ensures bubbler never drops below minimum level



Catalytic Burn Boxes

*Zero VOC Exhaust
Catalytic Oxidizers*



Catalytic Burn Boxes at each end of the oven remove all unused formic acid, carbon monoxide and hydrogen produced in the fluxless reflow process...

(Molecular hydrogen and carbon monoxide are thermal decomposition by products of formic acid...)



Formic Demo Machine Inside Class 10K Clean Room Florham Park, New Jersey



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Heller Industries Announces Joint Development Agreement with IBM for Fluxless Mass Reflow Soldering Process for High Volume Manufacturing

FLORHAM PARK, NEW JERSEY, July 29, 2013: Heller Industries announced today that they have entered into a joint development agreement with International Business Machines Corporation (NYSE: IBM), to collaborate on the development of fluxless mass reflow furnace equipment and process for high volume manufacturing. The fluxless process utilizes gas phase formic acid to replace standard fluxing agents, and eliminates the need for pre-reflow fluxing and post-reflow flux cleanup steps.

Heller Industries and IBM Microelectronics will jointly develop the optimum materials, equipment, process parameters, monitoring systems and thermal profiles required to implement the fluxless mass reflow tooling and process in a high volume manufacturing environment.

“Advanced semiconductor device packaging presents the industry with significant challenges due to reduced bump size and increased I/O density.” said David Heller, CEO of Heller Industries. “The gaseous fluxing process may become instrumental in helping our customers develop their next generation chip packaging technologies. In entering this agreement Heller and IBM will take advantage of Heller’s thermal management and equipment development expertise and IBM’s wide range of experience, technology and process knowledge for advanced component packaging.”

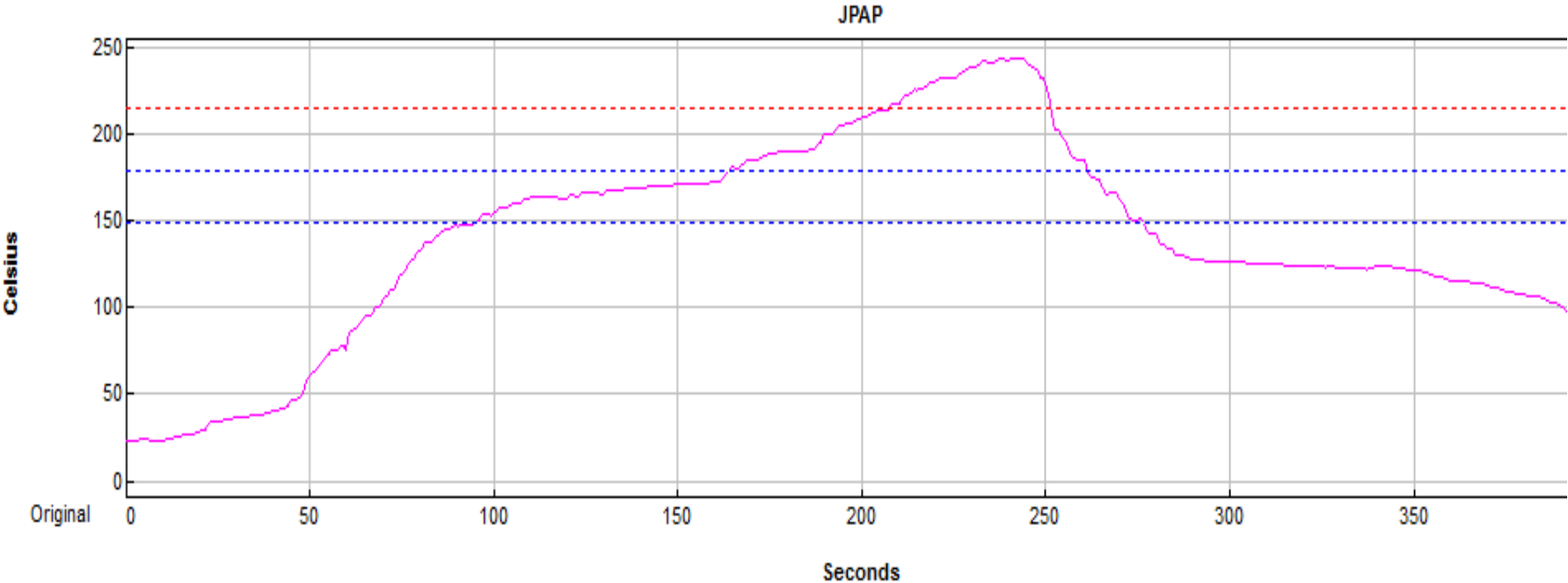
The joint Heller & IBM team will implement the program at the Heller Industries corporate headquarters in Florham Park NJ, IBM’s manufacturing facility in Bromont, Canada and at IBM’s state-of-the-art Semiconductor Research and Development Center in East Fishkill, N.Y.



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SAC Solder Reflow Profile



TCs	Soak Time 150-180C		Reflow Time /217C		Peak Temp					
<TC1>	68.60	-43%	43.78	-24%	246.08	122%				
Delta										

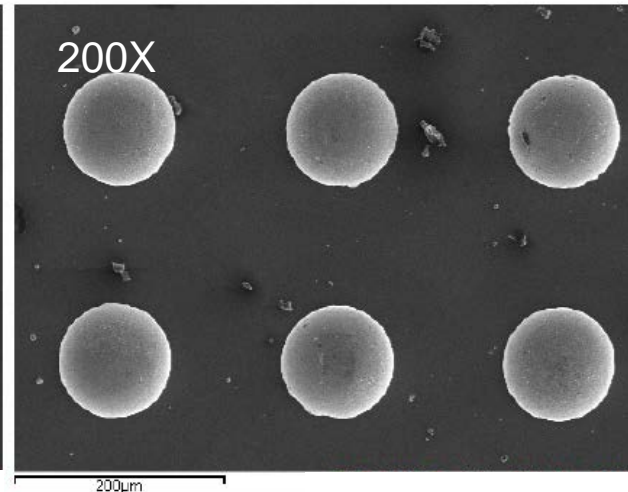
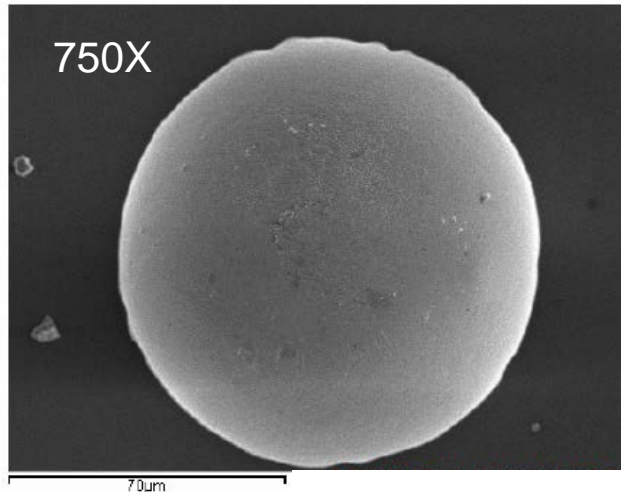
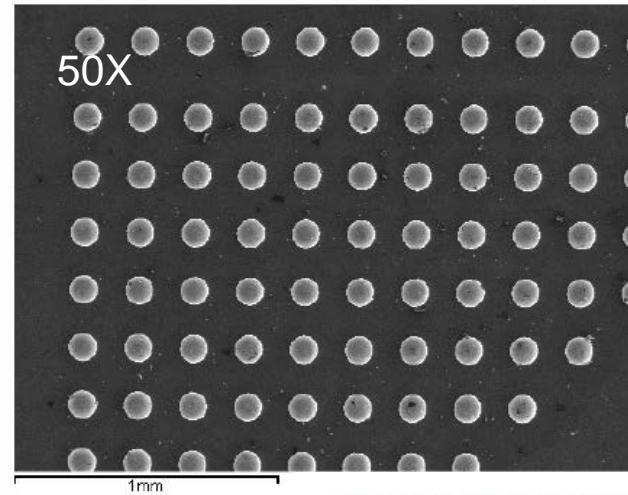


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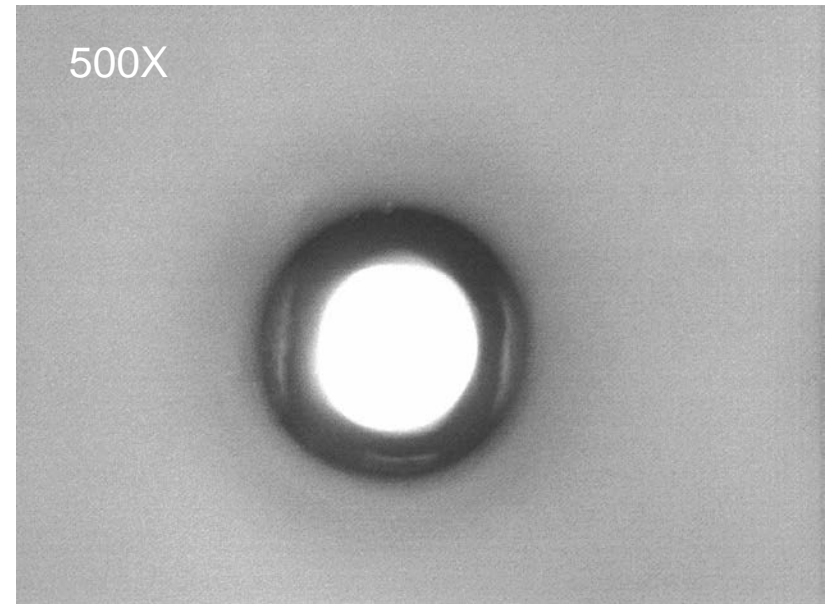
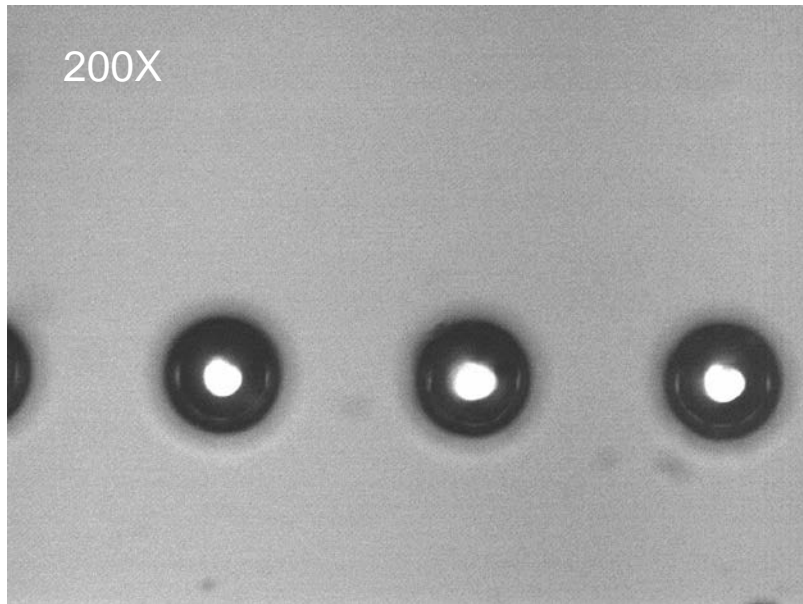
Fluxless Reflow Bumping

- *Formic acid peak concentration 4.27%*
- *SEM Micrographs indicate excellent, very smooth results*



Fluxless Reflow Bumping

Optical Micrographs - Formic acid peak concentration 4.27%

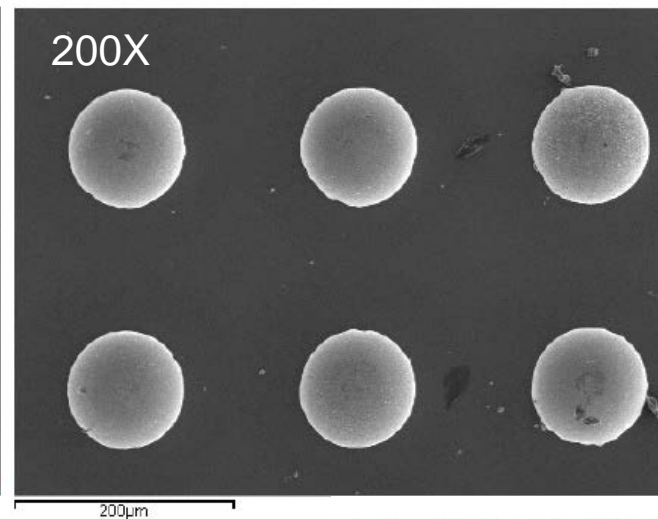
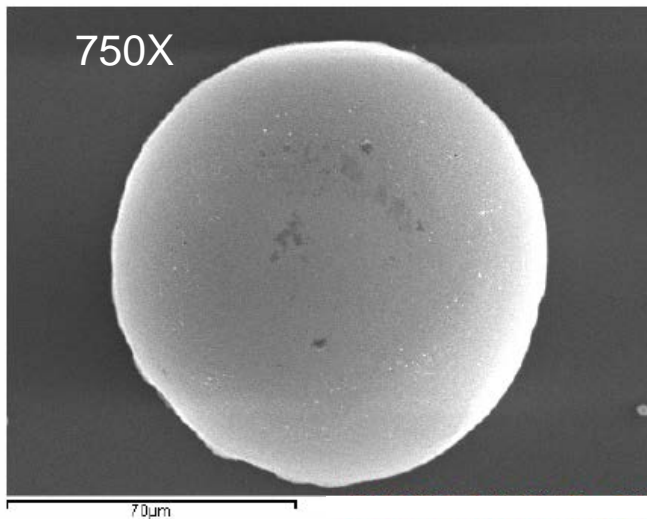
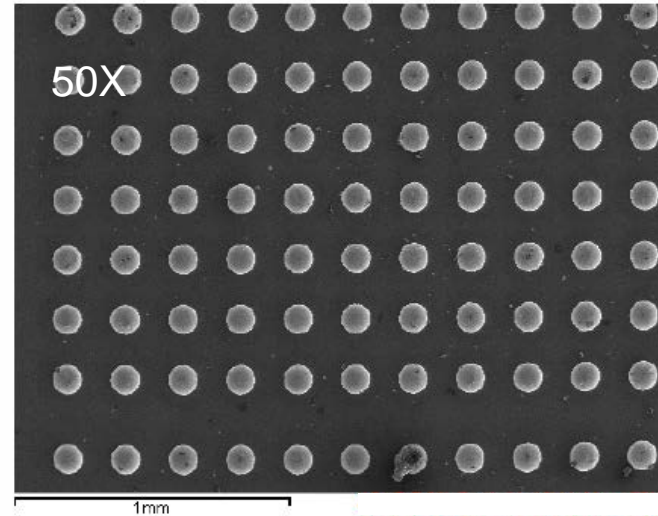


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Fluxless Reflow Bumping

- *Formic acid peak concentration 7.8%*
- *SEM Micrographs indicate excellent, very smooth results*



Heller Fluxless Reflow Summary

- Formic Acid has been shown to be an effective reducing agent in fluxless solder reflow
- Excellent results demonstrated for wafer bumping application in horizontal reflow oven
- Heller has designed and built an production ready horizontal reflow oven for this application.
- This new oven has been designed to meet Semi S2/S8 safety standards (including toxic gases).
- The Heller Oven is available for testing and development activities in Florham Park, New Jersey.



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