

# A Particle Removal Study Using JTB-111

With particle contamination directly reducing yield, wafer cleaning processes are required to be highly efficient at particle removal. Taking this into consideration, Mallinckrodt Baker has performed a particle study, as described below, to prove that its revolutionary chemistry, the Baker-Clean® process with JTB-111, is superior to the standard RCA cleaning process. The following results show the superior performance of JTB-111.

## EXPERIMENTAL

The particle measurements for the study were conducted using a PMS 3600 Particle Counter. The sample wafers were phosphorous doped virgin wafers used as received from the manufacturer. First, the wafers were contaminated using standardized Polystyrene Latex Spheres (PLS), sizes of 0.1, 0.2, and 1 µm in a water solution to challenge the cleaning process. The wafers were then counted to determine the extent of the contamination. Split lots were conducted with half of the wafers going through a full RCA clean process and the remaining half going through the Baker-Clean process. After the cleaning processes the particles on the wafer's surface were re-counted.

The RCA process was run as follows:  
 SC-1 (NH<sub>4</sub>OH:H<sub>2</sub>O<sub>2</sub>:H<sub>2</sub>O) (1/1/5), 70°C for 10 min.  
 SC-2 (HCl:H<sub>2</sub>O<sub>2</sub>:H<sub>2</sub>O) (1/1/5), 70°C for 10 min.

The BakerClean process was run as follows:  
 JTB-111 (JTB-111:H<sub>2</sub>O<sub>2</sub>:H<sub>2</sub>O) (1/0.22/5), 70°C for 10 min.

To provide clarity to the cleaning efficiencies of the two processes, the percent of particles removed was calculated. The particle counts on the virgin wafers were also compared with clean particle counts to aid in the understanding of what type of particles are removed during the cleaning process.

**Table 1. Particle Removal**

Chemistry	Contaminated Particle Count*	Cleaned Particle Count*	Particles Removed
RCA	573	383	33%
JTB-111	720	53	93%

\*These are particle count averages of four wafers

## DISCUSSION

It should be noted that 1) there was no filtration or re-circulation used in the baths for the study and 2) the particle contamination on the wafers is much higher than would be expected under fab-like conditions. These two conditions do not directly affect the cleaning trends determined. They do, however, further highlight the comparative cleaning effectiveness by modeling a filtration failure in the manufacturing process.

The fact that the wafers cleaned using JTB-111 have 93% of the particles removed from the surface, whereas RCA process only removed 33% of the particles, demonstrates the greater efficiency of JTB-111. In addition, it can be seen from Table 2, data collected from the same wafers, that JTB-111 and the BakerClean process is leaving the wafer with less particles than it started with. This is not the case with the RCA cleaning process. This suggests that JTB-111 is not only removing the PLS contamination but also virgin particles from the wafers surface. Also, in these very challenging conditions the RCA process added particles to the surface of the virgin wafers.

**Table 2. Virgin particle removal**

Chemistry	Virgin Particle Count	Clean Particle Count
RCA	54	383
JTB-111	68	53

Clearly, the BakerClean process is efficient not only at removing particulate contamination from the wafer's surface but also at preventing the re-deposition of the particles. In both removal and prevention the BakerClean process is superior to the RCA cleaning process. This trend would hold if there was filtration and re-circulation added to the experimental baths to mimic fab conditions. The only change to the results is there would be a decrease in the particle contamination.

## CONCLUSION

Particle contamination is an important parameter that directly affects the performance of circuits. Improvements in cleaning chemistries, as demonstrated with JTB-111 and the BakerClean process, has provided superior particle control to prevent yield losses. The benefit of using BakerClean is a more efficient and productive cleaning process for fabrication facilities.

## APPLICATION NOTE

Mallinckrodt Baker, Inc. has a staff of applications engineers who are eager to provide customer support during the evaluation and the use of the BakerClean product line. Applications engineers are also available to assist in experimental design modification, process 'trouble- shooting', and materials. MBI's application staff is always available to answer any question about the J.T.Baker Product line.

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## PRODUCT LISTING:

Description	Product Numbers
BakerClean JTB-111	6422-05; 6432-09

## Mallinckrodt Baker Microelectronic Materials

### U.S.A.

Mallinckrodt Baker, Inc.  
222 Red School Lane  
Phillipsburg, NJ 08865  
Tel: 1-(800) 582-2537  
1-(908) 859-9346  
Fax: 1-(908) 859-6904  
E-mail: micro.mbi@tycohealthcare.com  
Web: www.jtbaker.com/micro

### Europe

Mallinckrodt Baker B.V.  
Teugseweg 20, P.O. Box 1  
7400 AA Deventer,  
The Netherlands  
Tel: 31-570-687500  
Fax: 31-570-687574  
E-mail: jtbaker.nl@  
emea.tycohealthcare.com  
Web: www.jtbaker.com/micro

### Malaysia

Mallinckrodt Baker Sdn. Bhd.  
26 Jalan SS 26/13  
Taman Mayang Jaya  
47301 Petaling Jaya,  
Selangor D.E., Malaysia  
Tel: 60-3-7803-0378  
Fax: 60-3-7803-0405  
E-mail: sales@tycohealthmbm.com  
Web: www.jtbaker.com/micro

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