Fully Flexible Chemical Dispense System for SEZ Single Wafer Wet Cleaning Tools.

Customer requirements for single wafer wet cleaning tools

1. High process stability:
   - Constant etch rates on wafers
     - concentration of process media
     - temperature of process media
     - media flow rate onto the wafer
   - Lowest Contamination
     - particle contamination
     - metal contamination
     - cross contamination

2. Low cost of ownership
   - Small Footprint of tool
   - High wafer throughput
   - Low media consumption

Contradictory requirements for flow concept
Standard SEZ flow concept – Filling by measuring volumes

Volume measuring methods:
- Level sensor in Tank – bad accuracy
- Paddle wheel (PW) – big volumes, good accuracy
- Puffer pump (PP) – smaller volumes, good accuracy

Mixing DHF
1. Adding DI into Tank – using paddle wheel
2. Adding HF into Tank – using puffer pump

Not ready to use
Inhomogeneous temperature

Standard SEZ flow concept - mixing

Recirculation of mixture:
- Make mixture homogenous
- Heat mixture with inline heater
- Multi pass filtration

About 1h
DHF is ready to use
Standard SEZ flow concept - processing

- Wafers are processed with dHF
  - Constant etch rates over wafer
  - Constant temperature
- Low cost of ownership
  - Low media consumption - reclaim

Standard SEZ flow concept - spiking

- Slow concentration change of HF due to
  - HF consumption during etching
  - Evaporation of DI and HF
- Low cost of ownership due to spiking
  - Bath life time is increase dramatically
  - Spiking is done during processing (wafer through put)
Standard SEZ flow concept - processing

- Continue with processes
  - spiking

- Bath lifetime is reached
  - After certain time
  - After certain wafers

After x wafers

Standard SEZ flow concept - emptying

- whole tank is drained
Standard SEZ flow concept – empty total system

Standard SEZ flow concept - Mixing

- Standard filling procedure
Two tank SEZ flow concept – continuous processing possible

- Continuous processing with two tank system - high throughput
  - One tank is for processing
  - One tank for mixing

New requirements: process to drain

- Maximum process safety
- Low CoO Production
Different arguments for Drain and Reclaim mode

- No contamination from previous processed wafers
  - No metal contamination
  - No particle contamination
  - No cross contamination
- For high diluted Chemicals
  - dHF
  - SC-1
  - SC-2, dHCl
- Increase requests in 45nm nodes
- R&D prefers process to drain

- Low cost of ownership
  - Less amount of chemicals used up
  - Less volume for disposal
- SEZ spin processors are able to reclaim up to 3 medias
- Mass production tool prefers reclaim option

Process to drain mode consumes big volume of media

- Huge volume of media goes into drain
  - The tank will be empty very soon
Special mixing system is required for Process to drain mode

Requirements:
- high accuracy in mixing concentration
- flexibility in mixing ratios
- broad range of possible mixing ratios
- high flow rates
- mixing on temperature
- homogenous media
- spiking possibilities

Standard mixing system does not work → Not ready to use

Ready – to – use mixing system keeps tank filled with media

- Ready to use mixing system refills tank within minutes
  - Starts to mix when media level is below auto fill level (AFL)
  - To High Level sensor

Ready – to – use Mixing system

AFL

HL
Ready - to - use mixing system need high quality flow control units

Constant flow e.g. 0,1 L/min

Mixing ratio 1:100
Total Flow 10,0L/min

Ready - to - use mixing system with temperature mixing possibility

Constant flow e.g. 0,1 L/min

Mixing ratio 1:100
Total Flow 10,0L/min

Temperature sensor
dHF Data of Ready – to – use mixing system

Max: 0.3483 wt% (+0.19%)
Min: 0.3467 wt% (-0.27%)
Aver: 0.3476 wt%
σ = 0.000316

Measuring device: Horiba HF-96

Optimization of highest process safety and CoO - process to drain and reclaim within one recipe

First few seconds of each wafer process to drain
Ready – to – use mixing gives full process flexibility

Advantages – SEZ flow concept

Excellent technical performance of ready – to – use mixing system

- Mixing ratios up to 1 to 5000
- Broad flow range of part streams without hardware changes (factor 1000 - from 4 – 4000 ml/min)
- Mixing flow rates up to 25 L/min (increase possible)
- High mixing accuracy: better than +/-1% of target concentration
- Up to 3 part streams (mixing DSP+: DI+ H2SO4 + H2O2 + HF)

Long lasting experience

- Installed system at different customers in Asia, Europe and US.

Flow concept is suitable for all process requirements

- Process developing tools prefer process – to – drain mode
- Production tools prefer reclaim mode (CoO)
- Switching within one recipe between Process to drain a reclaim is possible to optimize process results and CoO.
Thanks for your attention