

# What I Like and Dislike About My Applied Materials 9500xR Implanters

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# User Interface for Operators

- Generally very user friendly
- Manual job submission easy for operators
- “Assists” are very simple and descriptive
- Very easy for operator to see implant status in monitor screen
- Easy to prevent operators from ignoring assists and mis-implanting wafers

# Recipe Autotuning

- Generally very fast for SDS gases (3-5 min)
- 90% of tuning problems can be solved by restart (“Auto start from named recipe”)
- Of remaining 10% of tuning problems, 90% can be solved by “Auto beam shutdown” followed by “Auto start from named recipe”
- Only 1% of tuning problems require process or maintenance engineer intervention

# Automation

- SECS/GEM capability enables reliable interface to automation software
- Documentation of SECS variables is excellent
- Good support is available from vendor

# Beam Tables

- Very useful for developing new processes, e.g., Sb, In implants
- Helpful in creating very low beam current recipes
- Helpful in creating doubly and triply charged recipes

# Configurable Constants

- Wafer handling
- Oven settings
- SECS/GEM interfacing
- Scan speed tolerance
- Analyzer magnet calibration
- Dummy wafer management

# High Density Plasma Flood System

- Higher emission current of low energy ( $< 10$  eV) electrons helps gate oxide integrity
- Typically get 50 mA emission at  $I_{\text{arc}} = 1.5$  A,  $V_{\text{arc}} = 30$  V, guide tube = -10 V, Ar flow = 1.2 sccm
- Enables wheel current to easily equal or exceed -3 mA for 10 - 16 mA As beam on oxide wafers
- With standard PFS, overflowing is difficult

# Low Beam Current Recipes

- 9500xR can be used as a medium current as well as a high current tool
- Very stable beam currents down to 5 uA
- Use Ar as a co-gas to stabilize plasma
- Has ultra stable arc current supply for  $< 250$  mA  $I_{\text{arc}}$



# Quadrant Implants

- Maxim tools have 0 - 7 deg tilt capability
- Batch notch orienter enables 7 deg tilt, 4 quadrant implant capability
- Wafer has to be loaded and unloaded from wheel for each quadrant
- 24 wafer 8" lot will require 4 orientations and a total of 8 wheels
- -10/+10 deg tilt option eliminates unloading

# Ovens

- Special antimony kit allows oven to run Sb
- Use dedicated source for cleanliness
- High, stable beam currents
- Best known methods provided by vendor
- Conditioning capability allows raw material to be loaded without bake

# Field Process Support

- Three process engineers located in Santa Clara, CA office
- Provide excellent support on all process issues
- Will look at customer's device problems to see if they are implanter related
- Have direct access to Horsham factory and Santa Clara applications lab

# Field Service Bulletins

- Vendor supplies frequent FSBs when necessary
- Communication is usually about a tool deficiency
- No attempt to hide weaknesses when they are discovered
- Well written and very useful

# Spin/Scan Module

- Scan speed is critical to dosimetry
- Scan speed intermittently is incorrect due to software delays or hardware failures
- Interlock will alarm if 2 consecutive scans have out of tolerance speeds
- Difficult to reconstruct what happened before alarm

# Beamstop Dosimetry

- Beam current measured only once per scan, with wheel at at min-scan position
- Accurate dosimetry depends on beam current stability
- Instabilities may be caused by arc voltage instability, arcing, beam size too large, material feed variability, vacuum changes, supply voltage instabilities
- Recipe parameters are key for robust operation

# Wafer Handling

- Wafer handling requires much monitoring and maintenance
- Torque with which transfer arm delivers wafer to heatsink is prone to drift
- Wheel indexing can drift
- Multirail supply controlling scan brake can fail, causing scan brake burnout

# Spare Parts

- Domestic inventory of spares is limited
- Parts which come from the U.K. must clear customs
- Can take several days to obtain a part from the U.K.



# Problem Escalation

- Very time consuming to escalate through field service if field process support can not solve the problem
- Many layers of escalation, each of which takes ~ 48 hours
- May take 1-2 weeks to get to Horsham factory
- Factory experts are not supposed to respond directly to customers

# Flight Tube Design

- Flight tube is not bolted to rest of tool
- Flight tube is held by vacuum only
- O-ring seal at both ends of flight tube is unreliable and prone to leaks
- $1\text{E}-5$  mbar range leak in this region causes overdoses as large as 5%

# Conclusions

- Applied Materials 9500xR is an excellent tool for high current operation and a good tool for medium current operation
- My likes far outweigh my dislikes
- Applied has been very receptive to helping with the dislikes even though Maxim has no service contract
- Many of the dislikes have been addressed with upgrades to the 9500xR that Maxim did not buy or in newer models (e.g. Quantum)