technical brief ... July 7, 2004

How to use CHARM®-2 wafers . . .

Since charging damage is typically associated with large-area charging non-uniformities, virtually all charging damage reduction work can be carried out with bare CHARM-2 wafers. The proper application procedures for the different processes are as follows:

- **Resist ashing:** Since resist ashing does not remove any material from the surface of a wafer, CHARM-2 wafers may be exposed to the ashing plasma for the entire duration of the ashing cycle, just like product wafers. In multi-wafer ashers (such as barrel ashers) position of the wafer in the load is often important!

- **Ion implantation:** Since ion implantation does not remove material from the surface of a wafer, CHARM-2 wafers may be exposed to the entire ion implant, just like product wafers. To observe resist-modulated changes in tool performance, the other wafers on the wheel may be resist-covered product wafers. Otherwise, tool performance and tool stability are best monitored when the "dummy" wafers are not coated with resist.

- **Plasma etching (including ion milling):** Since etching processes remove material from wafers, they can be lethal to CHARM-2 wafers. Metal etching is most dangerous since it can remove the probe pads, making it impossible to read-out the acquired information. However, since the CHARM-2 EEPROM-based sensors respond in less than a millisecond, a short exposure to etching plasma is sufficient to capture the charging and UV emissions characteristics of the plasma. To ensure that both the transient and steady-state of the plasma are adequately characterized, the exposure time should be sufficient for the plasma to reach a steady-state. In most cases, a 5 to 10 second exposure is adequate.

- **Oxide deposition:** Since it is essential to remove all deposited oxide from CHARM-2 wafers in order to read-out the acquired information, the deposition cycle should be as short as possible. To ensure that both the transient and steady-state of the plasma are adequately characterized, the deposition time should allow the plasma to reach a steady-state. In most cases, a 5 to 10 second deposition is adequate. The deposited oxide can be removed with plasma or a wet etchant. If it is removed with a plasma, the system used should first be characterized with a CHARM-2 wafer to ensure that the oxide removal process does not cause charging. If the deposited material is removed with a wet etchant, standard pad etchants, such as OLIN 777 Pad Etch, 16:3:3 Pad Etch, or the 21 Pad Etch, are recommended. An ammonium-fluoride-buffered HF (BHF) solution may also be used, since it is significantly less aggressive toward the Aluminum metalization on CHARM-2 wafers than water-HF solutions. To further reduce the etching of the metalization on CHARM-2 wafers, the overetch time in the BHF solution should be minimized. This can be accomplished by calibrating the BHF etch time using a bare silicon wafer which received the same deposition as the CHARM-2 wafer.

- **Metal deposition:** Since metal deposition will short all probe pads on the CHARM-2 wafer, it is essential to remove the deposited metal from the CHARM-2 wafer in order to read-out the acquired information. To facilitate this, the deposition cycle should be as short as possible. To ensure that both the transient and steady-state of the plasma are adequately characterized, the deposition time should allow the plasma to reach a steady-state. In most cases, a 5 to 10 second deposition is adequate. The deposited metal can be removed with plasma or a wet etchant. If it is removed with a plasma, the system used should first be characterized with a CHARM-2 wafer to ensure that the metal removal process does not cause charging. If the deposited material is removed with a wet etchant, the overetch time in the metal-etch solution should be minimized. This can be accomplished by calibrating the etch time using an oxidized silicon wafer which received the same deposition as the CHARM-2 wafer.

- **Other processes:** Contact WCM for recommendations.

For additional information, please contact: **Wafer Charging Monitors, Inc.**
127 Marine Road, Woodside, CA 94062
tel. (650)851-9313 fax. (650) 851-2252
email: wes@charm-2.com