FIELD TESTING OF THE EX WAFER MAPPING SENSORS

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Qualification: An EX wafer mapping sensor, developed for 200 mm and 300 mm applications, was tested in a 300 mm fab under the following conditions:

- Dark wafers were saved for a number of months until two FOUPS could be populated with wafers that the WX sensor could not reliably detect. Bare silicon wafers were mixed with these wafers.
- Two types of FOUPS were used, Asyst and Entegris
- Each individual test was run 20 times in succession to ensure that there were no instances of the EX sensor marginally sensing the wafers.
- Tests were done with the notches all placed in front of the sensor, notches all placed away from the sensor, and with notches in random order.
- Tests were done with the wafers re-slotted in random order so that any tendency for the sensor to work better at the top or bottom of the FOUP would be evident.
- The tests were repeated in two tools.

The table below summarizes the data. The EX sensor correctly sensed every wafer every time in every test. The EX sensor never indicated a false cross-slot event.

	Map with Asyst		Map with Entegris		Notch Front		Notch Back		Re-slot Random Order	
Wafer	**WX**	**EX**	**WX**	**EX**	**WX**	**EX**	**WX**	**EX**	**WX**	**EX**
Isolation Nitride	X	O	X	O	X	O	X	O	O	O
PSG	O	O	O	O	O	O	O	O	O	O
Poly	X	O	X	O	X	O	O	O	O	O
W-dep	O	O	X	O	O	O	O	O	O	O
TiN Adh	X	O	X	O	X	O	X	O	O	O
BTBAS	X	O	O	O	X	O	O	O	O	O
TaN	O	O	X	O	O	O	O	O	O	O

Table 1. Qualification Test Results (X = miss, O = hit)
PSG – Phosphosilica Glass
Poly – Polysilicon
W-Dep – Tungsten Deposition
BTBAS – bis (tertiary-butylamino) silane

The EX sensor was tested with “back ground” wafers in the range of 0.12-0.18 mm thick. These wafers had been difficult for the WX sensor to reliably sense. The EX was tested on such ultra-thin wafers at CyberOptics Semiconductor (formerly HAMA Sensors) and then the EX was tested at an external fab on newly fabricated back ground wafers. In all cases the EX successfully sensed the wafers.

The combined laser output of the two lasers is 0.76 mW. The lasers are modulated at 8 kHz and synchronously detected to eliminate interference from other light sources. Tests indicate the EX sensor will trigger when it receives 3 pulse edge transitions from the wafer at an approximate power level of 2 nW. The laser stripes are typically 130 to 160 microns wide at the wafer. Therefore, the detectors will trigger when they receive 0.0000026 of the light that hits the wafer edge. A bare silicon wafer is between 30 and 35% reflectivity at the sensor laser wavelength. Even though some of the nitride and oxide coatings look very dark, the darkest measured reflectivities are higher than 3%. The EX sensors will detect wafers with reflectivities well below 0.5%.

Conclusions: The new EX wafer mapping sensor successfully maps all of the available test wafers including all wafers that the WX sensor could not see. These include wafers ranging from very dark to bare silicon. In anticipation of future, darker coatings, performance “head room” through increased sensitivities was created and verified. Wafers of all standard SEMI diameters and edge geometries were evaluated and detected. The design changes incorporated in the EX are based on logical optical and electronic engineering considerations and the test results confirm the logic of the changes. These changes were performed without requiring any mechanical mounting or electronic changes. The changes are not “tuned” to any particular wafer characteristic so that future changes in wafer optical characteristics are unlikely to require additional sensor changes.