PHYSICAL ELECTRONICS

DEFECT NAVIGATION ON WAFER PIECES

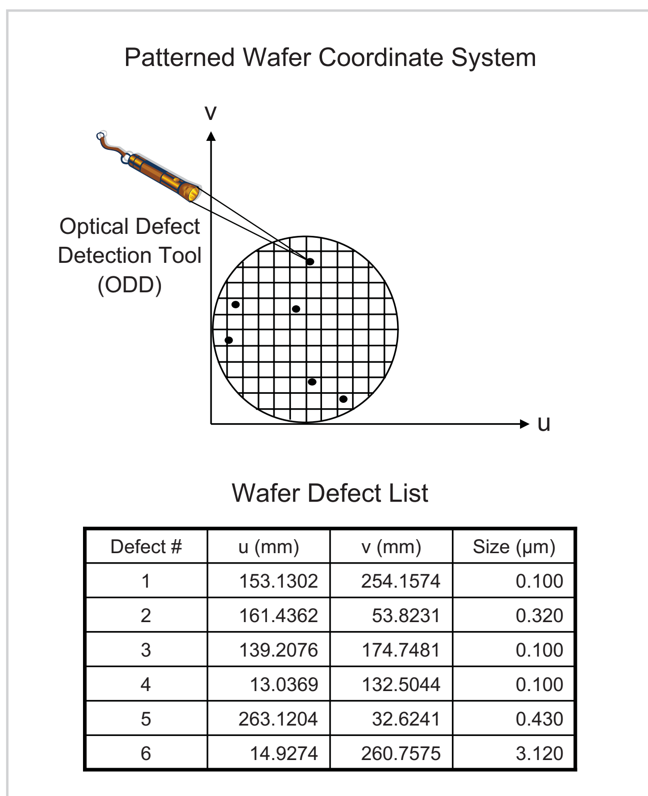
With the *PHI 700 Auger Nanoprobe*

INTRODUCTION

Defect characterization has become extremely important to the semiconductor and the data storage industries. In-line tools such as ODD (Optical Defect Detection), AFM, and SEM provide a wealth of information about the size and distribution of defects. Today, killer defects are often too small or thin to be characterized with in-line EDS capabilities. To identify these ultra small or ultra thin defects the wafers are typically sent to the "lab" for analysis. In the lab, wafers are frequently cleaved to provide small wafer pieces that can be easily inserted into high performance micro-analysis tools such as the *PHI 700 Scanning Auger Nanoprobe*. The *PHI 700* routinely detects contaminant residues that are less than 1 nm thick and particles as small as 30 nm. To simplify the task of relocating defects in the *PHI 700*, a die navigation capability is available that uses industry standard position lists for calibration and navigation.

In this application note we will describe the methodology for navigating to a specific defect on a piece of a patterned wafer.

The in-line ODD tool in the FAB generates a wafer defect map that provides U-V coordinates and defect size information as shown in figure 1.



Defect #	u (mm)	v (mm)	Size (µm)
1	153.1302	254.1574	0.100
2	161.4362	53.8231	0.320
3	139.2076	174.7481	0.100
4	13.0369	132.5044	0.100
5	263.1204	32.6241	0.430
6	14.9274	260.7575	3.120

Fig. 1: ODD finds and records defect positions and establishes a U-V coordinate system

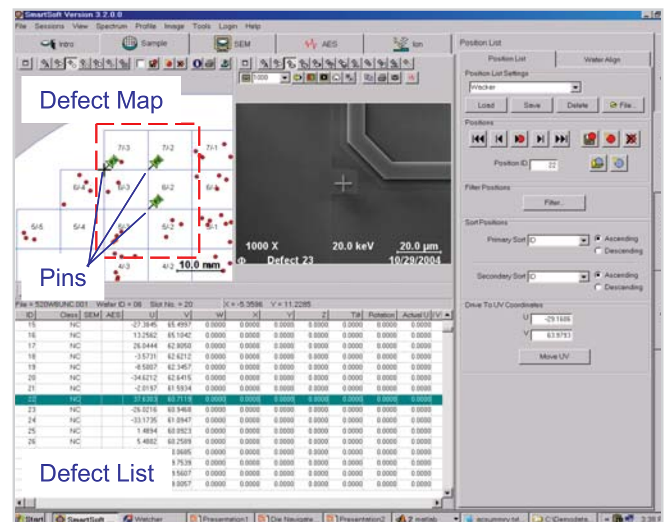


Fig. 2: Placement of pins on the defect map specifies *PHI 700* sample stage X-Y coordinates of wafer landmarks that have known U-V coordinates from the original position list

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METHOD

Using the *PHI 700's* SEM capability, three landmarks are located and flagged with placement pins as shown in figure 2. For patterned wafers, die corners are the most commonly used landmarks. The specific X-Y sample stage positions for the three "pinned" die corners are correlated to the U-V coordinates of the die corners from the original position list.

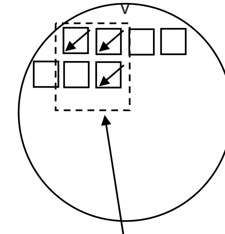
When this correlation is completed, PHI's *SmartSoft* defect navigation software module can be used to navigate to small defects on a wafer piece using coordinates from the original position list. The relocation accuracy is such that a defect will be found within a 20 µm field of view if the ODD tool is well calibrated.

Once the defect has been located, Auger analysis can be performed to determine the composition of the defect as shown in figure 4.

SUMMARY

We have shown that PHI's *SmartSoft* defect navigation software module can be used to quickly relocate ultra small defects from standard position lists and characterize them with Auger spectra, maps, and sputter depth profiles if needed.

"Landmarks" that are Visible in Secondary Electron Images are Needed for Defect Navigation



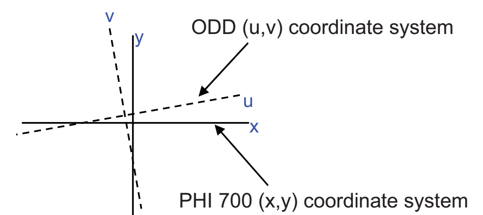


Fig. 3: Die corners are used to match the ODD and *PHI 700* coordinate systems

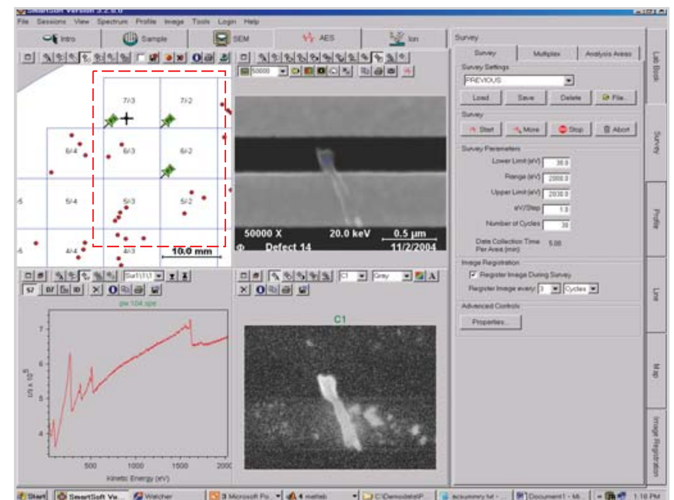


Fig. 4: Defects on a patterned wafer piece are quickly located and characterized using the *PHI 700* and *SmartSoft* defect navigtion software

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