Advanced confocal microscopy for rapid 3D analysis

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Introduction

Advanced Confocal Microscopy (ACM) is a relatively new technology combining high-speed parallel data collection with advanced modeling and measurement routines to acquire and render a comprehensive 3D model of the sample surface, with sub-micron detail, in seconds.

All confocal microscopy provides spatial resolution in the z-direction by using an aperture to exclude detection light that does not originate in the focal plane of the optical system. To do so, it must acquire data sequentially as the aperture addresses all points in the object. Various confocal technologies accomplish this in different ways, but the sequential nature of the acquisition imposes a fundamental limit on speed. Disk-based systems offer a significant speed advantage, because they acquire data simultaneously from multiple apertures arranged in a spiral pattern on a rapidly spinning disk.

Advanced control, analysis and modeling software automatically generates a three-dimensional model of the sample, allowing x/y/z metrology precision in the nanometers. Quickly acquired, with minimal sample preparation, the data rivals that obtained, destructively, from the most careful SEM cross section measurement.

Application

After alignment, the wafer can be stepped around, using the stage, to bring any desired coordinate under the objective, with a Move-Acquire-Measure (MAM) time – without any particular optimization – of about 45 seconds.

Key to this process is the ability to automate measurement, under recipe control, of features that may show up on any part of the target pad. This is achieved by using pattern recognition (PR) tools to position the measurement tools over the probe mark.

Multiple measurements may be made without significantly adding to the acquisition time. If they can be performed under recipe control and the results exported for use, the tool becomes effective for defect review and for collection of large amounts of data for statistical treatments.

Conclusions

Previously, the investigation of the volumetric extent of probe marks has required that wafers be taken to the scanning electron microscope (SEM) for analysis. Furthermore, accurate depth measurement has required careful (destructive and time-consuming) cross-sectioning of the wafer.

Using the ACM, equivalent data is rapidly acquired. The wafer is not damaged and the volume of data that it is reasonable to collect is increased by several orders of magnitude: given a stepping pattern for a probe card, for instance, it is straightforward to set up a recipe to analyze all probe marks made by a particular tip on the card. Statistical process control applications begin to make sense.

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For further information

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