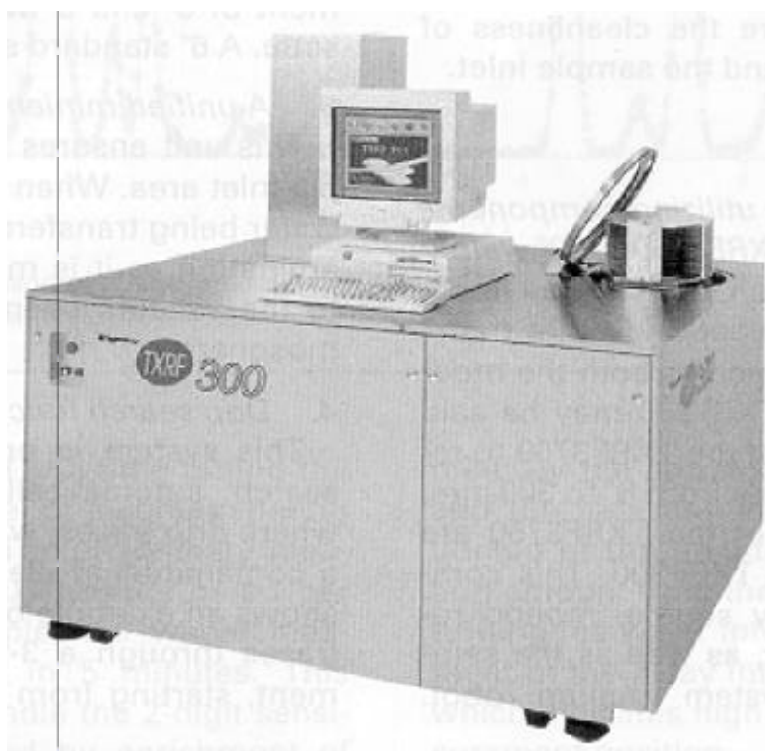


Total Reflection X-ray Fluorescence Spectrometer

TXRF 300



Introduction

With the 21st century in sight, semiconductor plants are actively promoting an ever higher rate of LSI integration along with an aggressive cost reduction. Their current goal is the production of very large 300 mm wafers. Immediately following the trial production lines whose construction began in 1998, mass production lines for 300 mm wafers are expected to increase during the year 2000. Accordingly, peripheral manufacturing systems designed to handle such superlarge wafers are quickly nearing completion. The standardization of systems designed to handle 300 mm wafers has recently been pushed forward aggressively. This is to keep pace with the automation and enhanced reliability of the wafer transfer system accompanying the trend toward ever larger dia. wafers. It is also intended to put a curb on

sharply increasing plant construction costs and development expenses. It is against such a background that the Rigaku/Total Reflection X-ray Fluorescence Spectrometer TXRF300 has been developed as a definitive version for the analysis of contamination on 300 mm wafers. It is specifically designed with the demand for standardization in mind, while maintaining high reliability. As such, through the evaluation of wafer contamination, this system will take its role in contributing to the earliest possible start-up of LSI production facilities.

The TXRF300 maintains 80 percent or more compatibility with the existing TXRF3750 for 8" wafers in terms of system configuration and components. The TXRF300 is a newly developed, yet highly stable analyzer employing Rigaku's transfer systems and vacuum components, features with proven reliability for keeping wafer free from

contamination. This function is most important for semiconductor wafer analysis. The new system also retains the highly reputable features of the TXRF3750, such as the function which eliminates interfering diffracted rays using an X-Y- θ sample stage. Additionally, the function that searches for the orientation notch and wafer center on the stage, and the single target three-beam method which allows a wide range of element analysis are incorporated. Moreover, the automation program with SECS has been restructured to comply with the GEM standard, thus allowing FOUP (Front Open Unified Pod) coupling. A unified minienvironment unit and air filter are provided as well to properly secure the cleanliness of space between the FOUP and the sample inlet.

Features

1. High reliability due to utilizing components in common with the TXRF3750 for 8" wafers

The system configuration, as well as most components including a robot and other transfer system parts, are common to both the models. In essence then, the TXRF300 may be said to be a scaled-up version of the TXRF3750 to reflect the objective of analysis from 8" to 300 mm. Thus, many components of the TXRF3750 are readily utilizable with the TXRF300. This community includes the X-ray source, monochromator, SSD X-ray detector, as well as the sample stage and transfer system vacuum robot.

This is possible because the design and development of the predecessor model TXRF3750 took into account the future need for a 300 mm wafer system. This enhances high dependability of the new model.

Also, the rotating anode X-ray tube maintenance schedule requirement have been reduced twofold compared with previous models due to a new mechanical seal.

2. Operable with FOUP to allow analysis of 8" and 6" wafers also (with user's cassette)

A simple cassette exchange allows measurement of 8" and 6" wafers using a 25 slots cassette. A 6" standard sample is usable.

3. A unified minienvironment unit

This unit ensures the cleanliness in the sample inlet area. When coupled with the FOUP, the wafer being transferred is guarded against contamination as it is moved from the pod interior to the vacuum chamber interior in a clean atmosphere.

4. Drip search function

This system is provided with a function to search automatically for points of analysis where drip traces, where high concentrations of a contaminating element are likely. The figure shows an example of locating the center of drip traces through a 3-time preliminary measurement, starting from a point about

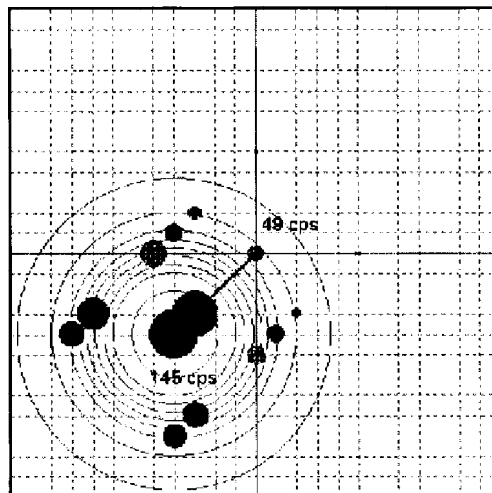


Fig. 1. Automatic drip search process

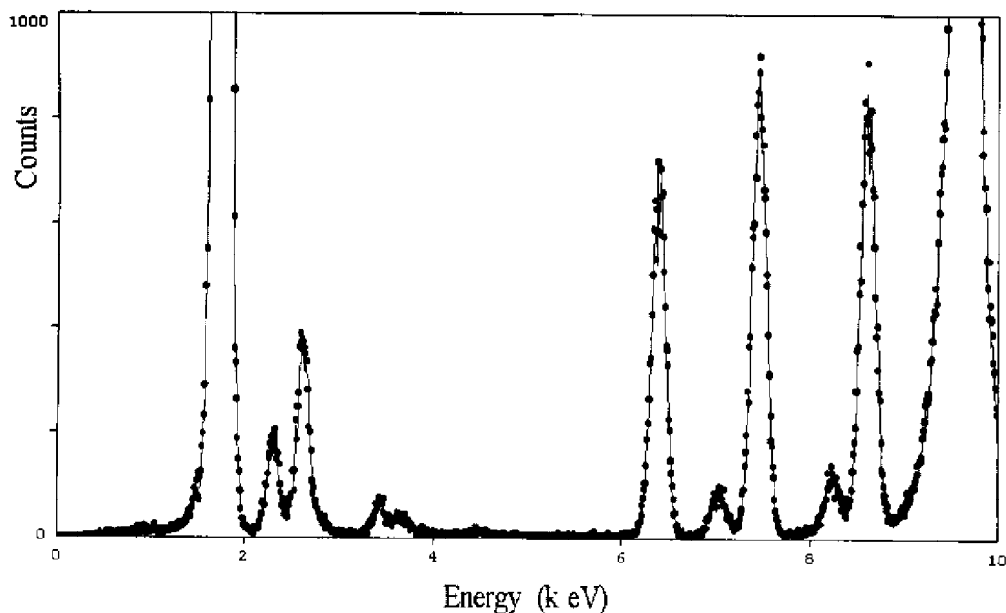


Fig 2. Comparison of measurement by measuring position search and that by direct designation of drop position.

6 mm away. Five points were measured at a time to find the point where the signal level of a contaminating element was the highest. The preliminary measurement was made in 10 seconds or so per point. In the given example, the whole measurement was completed in 5 minutes. This function is designed to handle the 2-digit sensitivity improvement enabled by enrichment of contaminants like VPD.

5. Particle analysis

It is possible to measure the wafer's orientation notch position and deviation of the wafer center from the stage center when a wafer is mounted on the sample stage. This function permits accurate positioning of the optional measurement point on the sample. With the sample stage driven by the X, Y, θ axes, no overlap of an interfering peak due to diffracted rays occurs at any sample analysis position. Therefore, regardless of particles at any position, the highest-performance analysis is always assured. Hence, no special skill is required to decide whether a given signal is due to contamination.

The figure shows data on the accuracy of the analysis position. An X-ray intensity comparison is made between the drip traces measurement by the afore-

mentioned drip search mode and the measurement taken upon direct positioning of the orientation notch and the deviation amount from the stage center after once returning the wafer into the cassette. Good agreement of the X-ray intensity is seen in this figure which indicates high reproducibility of the measurement position.

6. Complying with GEM

The software is designed to be run on Windows 95 or Windows NT making it easy for data communication. Host computer control is possible which complies with the GEM standard for automation of 300 mm wafer plants. (optional)

The TXRF300 features function and performance incomparable world-wide, as embodied in the X-Y- θ stage and the 3-beam X-ray source. It also easily handles the FOUP coupling and through-the-wall installation, and requires a minimum area for installation in the clean room. Moreover, it can easily deal with varied application analyses such as drip trace and particle analysis. The TXRF300 can certainly be said to be the definitive version of the wafer contamination analyzer.

Specifications

Sample wafer	Size	300 mm, 8", 6"
X-ray source	X-ray tube X-ray generator Monochromator	Rotating anode X-ray tube, W target Max rating: 18 kW, Routine operation: 30kV-300mA W-M, W-L β , HE (20 keV), 3-crystal exchange by switchover
Sample stage	Measurement position X-ray incidence angle setting	X, Y, Z, θ , ϕ drive allowing X-ray incidence direction control Z, ϕ drive
X-ray detector	SSD	Si (Li) effective dia.: 80 mm ² Be window: 12.5 μ m <180 eV (Mn-K α)
Sample transfer	Sample cassette Cassette chamber Measurement chamber	300 mm: 13 piece open cassette 8", 6", User's specified cassette Vacuum chamber (with a gate valve) With a vacuum transfer robot
Control and data processing	OS Measurement program Quantitative measurement Mapping display GEM	Windows 95 or Windows NT Fully automatic measurement, manual measurement, 3-beam automatic switchover measurement Peak identification, calibration curve curve method, quantitation with sensitivity coefficient 2-dimensional, 3-dimensional display, allows simultaneous display of up to 9 elements Compatible (optional)
Accessory equipment	Vacuum pump Feed water system Liquid nitrogen preparator & feeder	Dry pump (for X-ray tube, sample chamber). 2 sets Heat exchanger For SSD detector cooling; automatic feeder

Windows 95[®]: A registered trademark of U.S. Microsoft Corporation in the U.S. And other countries.

Installation Requirements

Dimensions & weight The parenthesized equipment depends on the installation conditions.	Basic unit	1700 x 1220 x 1700 mm 800 kg
	X-ray generator	600 x 900 x 1700 mm 420 kg
	(Vacuum pump)	330 x 442 x 369 mm 100 kgx2
	(Heat exchanger)	1700 x 1220 x 1700 mm 300 kg
	(Liquid nitrogen preparator & feeder)	1700 x 1220 x 1700 mm 120 kg
Utility	Power supply	3-phase, 200 V AC, 100 A Less than 100 Ω (individual)
	Grounding	(except for accessory equipment)
	Cooling water	> 24lit./min
	Gas	Clean nitrogen for purge, air for driving
Environment	Temperature, humidity	15 to 27°C, <80% RH
	Cleanliness	Below Class 100
	Vibration	Below 50 gal