

## **Development of Vertical Type High-Resolution RBS System**

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### 1. Introduction

Rutherford backscattering spectrometry (RBS) is widely used because of its stable performance compared with other methods. The first commercial system of high-resolution RBS (HRBS) was developed in 1992 for the surface characterization of materials. The HRBS technique achieves a high depth resolution with a few angstroms by a magnetic spectrometer with a high-energy resolution combined with a position sensitive detector that was developed by Kyoto University. It enables us to obtain a depth profiling with a 20 to 50 times higher resolution than can be obtained with a conventional RBS with a solid-state detector. This capability applies to an elemental profile in thin films or an elemental diffusion before / after annealing process in the field of semiconductor R&D and etc.

A newly developed vertical-type HRBS system consists of a new compact vertical accelerator, a detection angle changing system, and a new data acquisition and analysis software. This system provides a very small installation space, high reliability, fine measurement as well as an easy operation for surface analysis.

### 2. Technology

#### (1) Vertical accelerator

A newly developed accelerator generates up to 500 kV for helium ion beam which is led downward from the accelerator and bent to the horizontal direction by a bending magnet. Since it allows placement it on top of the bending magnet, the whole system reduces its installation footprint by 35% compared with the former horizontal-acceleration-type system. To achieve the small space and voltage reliability, a Cockcroft-Walton-type high voltage generating circuit is formed around an acceleration tube. The design is also based on an anti-

discharge technology, giving protection from unexpected discharges.

## (2) Detection angle changing system

The detection angle changing system has been developed for a higher accuracy measurement. It enables us to change the detection angle of a set of a measurement chamber and an analyzing magnet arbitrarily with high accuracy. That is, the measurement chamber and attached equipment rotate on a fine bearing centering around the vertical axis (Y axis) of the sample surface without breaking a high vacuum. The angle monitoring system with a linear scale and a feedback system enables us to set the angle with an accuracy of 0.1 degrees, accordingly improving the accuracy by a factor of 3.

## (3) Auto fitting software of HRBS spectra

An auto fitting simulation software has been developed to support an operator with a quick analysis. Using the software and the detection angle changing system, a reduction in measurement and analysis time of 60 % was achieved.

## 3. Conclusion

The newly developed vertical-type HRBS system has been commercialized as a model of HRBS-V500 and has already been installed to semiconductor manufacturers. In addition, HRBS analysis service business is in operation and the HRBS technique has attracted worldwide attention from international conferences of surface analysis, its reputation is spreading worldwide as a high precision system of analysis.

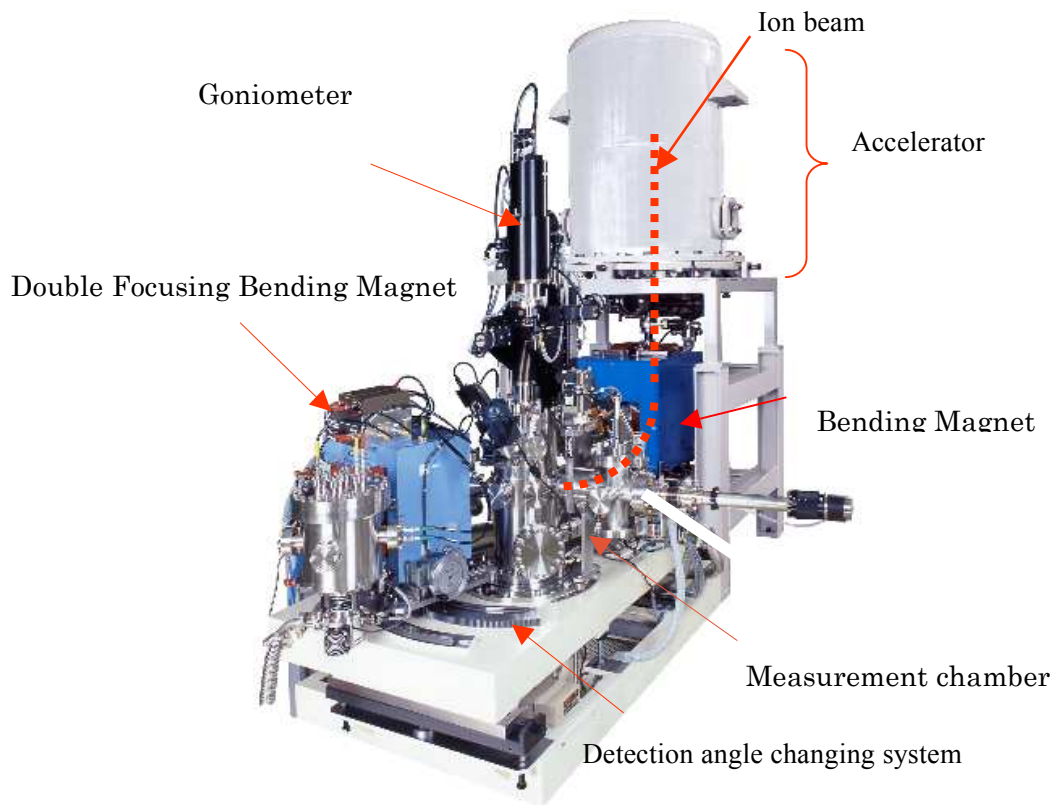


Figure 1 Vertical-type HRBS System

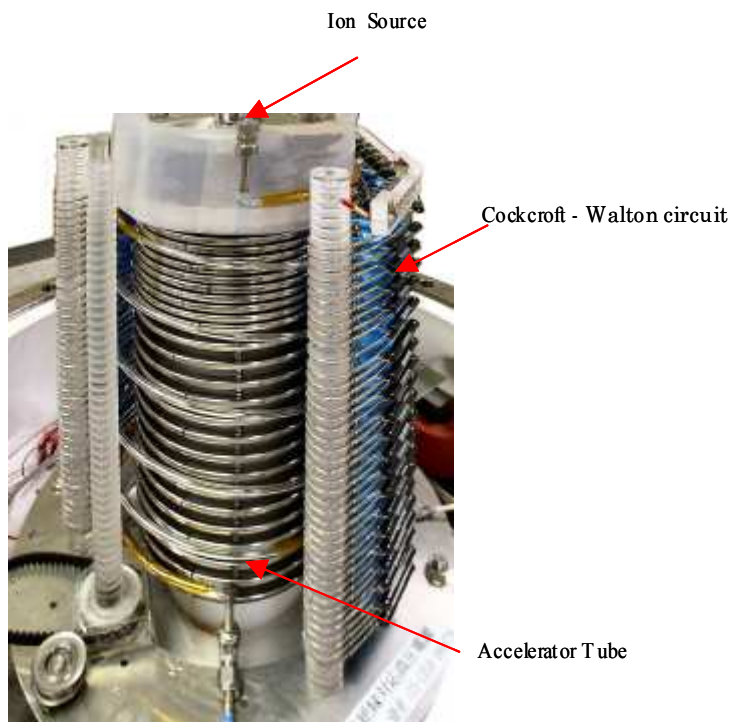


Figure 2 Vertical accelerator

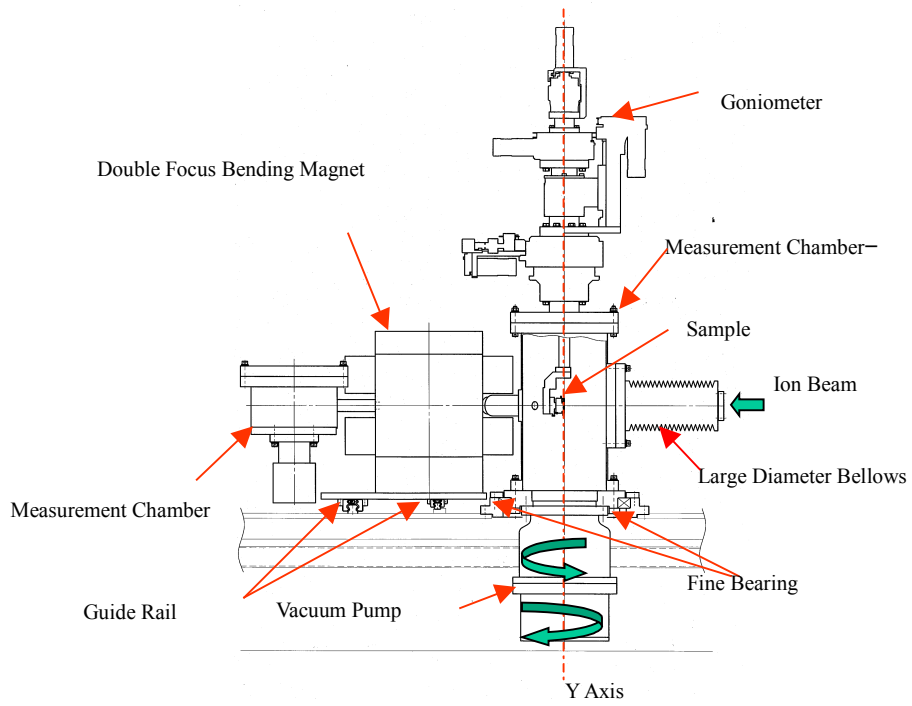


Figure 3 Detection angle changing system