Surface X-ray Diffractometer for Metalorganic Vaper Phase Epitaxy Growth

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Owing to the lack of *in situ* characterization tools for the atomic scale, the surface structures in gas phase growth are still uncertain. X-ray diffraction is a promising candidate, and expected to illuminate the growth mechanism in the atomical dimensions. To reveal the initial stage of III-V compound semiconductors, we developed a grazing incidence Xray diffractometer.

The diffractometer is composed of two sections: a goniometer and a gas handling system. One important function of the goniometer is maintaining the constant convective flow of material gases in order to obtain a uniform growth in a relatively large spatial area. During scans in the ordinally four-circle geometry, the surface orientation changes with respect to gas flow, and this results in non-uniform epitaxial growth. One type of geometry that can avoid this preoblem is a z-axis geometry[1,2].

To settle the gas handling problem, we set the reactor chamber including the sample stage and gas inlets on the θ stage, and the θ and 2θ stages are hanged on to the α stage which varies the incident angle. The take off angle β is changed with the height and angle of the detector stage set on the 2θ stage. In this geometry, the direction of the surface and the gas flow is maintained during the scans. To align the goniometer system, extra stages are attached for the horizontal and vertical translation, and rotation around the z-axis.

All axes and counters are controlled by the SPEC program running on a Linux-based PC. The beamline monochromator is independently controlled by an in-house program with connecting BL-WS via a network, and the drift of monochromator crystals is tuned from the SPEC program during the measurement.

The material gases are delivered with a conventional MOVPE gas handling system, consisting of carrier gas supply, material gas handling, and exhaust subsystems (Fig. 1). Hydrogen and nitrogen are used for carrier gases, and organometallic vapor sources are selected for material gases. To avoid the leaks and make the system safety, the whole system, including the goniometer, was isolated in the cabinet which is maintained at lower than atmospheric pressure. The wasted gases are neutralized and diluted with nitrogen below the explosion limits, and then exhausted by the scrubber installed outside of the storage ring building.

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(2) J. Matsui, Y. Kagoshima, Y. Tsusaka, Y. Katsuya, M. Motoyama, Y. Watanabe, K. Yokoyama, K. Takai, S. Takeda, J. Chikawa, SPring-8 Annual Report 1977, 125.

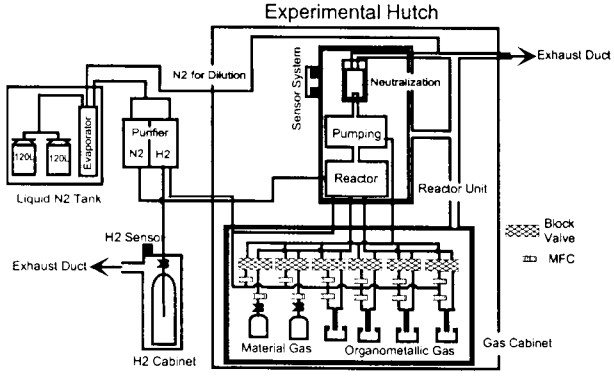

Fig. 1. Schematic view of gas handling system.