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RHEEDAX Induced X-ray Fluorescence Analysis System for Oxide MBE

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Hadis Morkoc, Ph.D.

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Virginia Commonwealth University
School of Engineering
Box 843068
Richmond, VA 23284-3068

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ONR REG ADMIN ATLANTA-N66020
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14. ABSTRACT

A total reflection x-ray fluorescence spectroscopy system excited with an electron gun of reflection high-energy electron diffraction tool (RHEED-TRAXS) for in situ material characterization has been designed, components have been purchased, and the tool has been assembled and installed on a Riber 3200 molecular-beam epitaxy system customized for oxide growth.

15. SUBJECT TERMS

X-ray fluorescence spectroscopy, molecular-beam epitaxy, reflection high-energy electron diffraction, in situ characterization, material composition

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FINAL TECHNICAL REPORT
Grant No. N00014-06-1-0854, Office of Naval Research
Principal Investigator: Hadis Morkoc, Ph.D., Virginia Commonwealth University

Equipment Acquired:

Set of equipment based on XR-100-CR X-ray detector (Amptek, Inc.) for assembling total reflection angle x-ray spectroscopy (TRAXS) system

Manufacturers included Amptek, Inc., Huntington Mechanical Laboratories, Inc., Pfeiffer Vacuum Inc., Kimball Physics Inc., and MDC Vacuum products corporation.

Total Costs: $25,068 (ONR)

The equipment funds provided under the above referenced grant have been put to use as intended. As proposed, a total reflection x-ray spectroscopy system excited with an electron gun of reflection high-energy electron diffraction tool (RHEED-TRAXS) for in situ material characterization has been designed (the schematic of the RHEED-TRAXS system is shown in Fig. 1), components have been purchased, and the tool has been assembled and installed on a Riber 3200 molecular-beam epitaxy system customized for oxide growth.

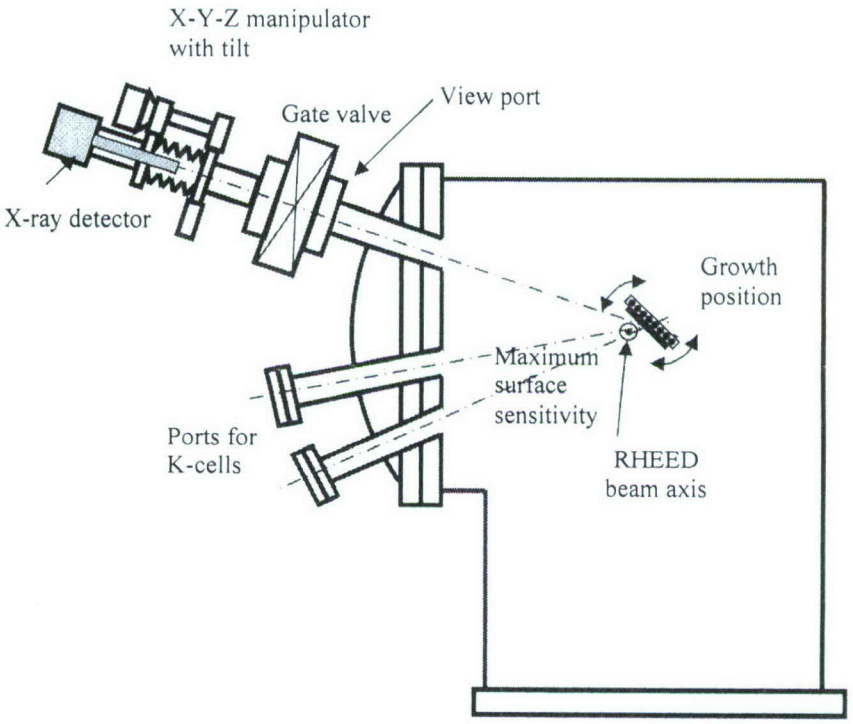

Fig. 1. Schematic of RHEED-TRAXS system designed for Riber 3200 growth chamber.

The system (shown in Fig. 2) consists of a compact and sensitive XR-100-CR X-ray detector with PX4 digital pulse processor mounted using CP75 feedthrough coupler (these components are manufactured by Amptek, Inc.) on a XYZ precise manipulator with tilt capability (Huntington Mechanical Laboratories, Inc.). The manipulator aimed for precise positioning of the x-ray detector and thus maximizing the signal intensity is connected using vacuum components (MDC Vacuum Products and Kimbal Physics, Inc.) to the conflate port of the ultra-high vacuum Riber 3200 molecular-beam epitaxy system. A compact turbo-drag station (Pfeiffer Vacuum Inc.) is used for differential pumping of the tool. The system was designed in such a way that allows one to utilize the substrate manipulator of the MBE system for controlling the angle of X-ray collection which is essential for improving the surface sensitivity. The RHEED-TRAXS system has been tested after the installation and the system is now fully operational.

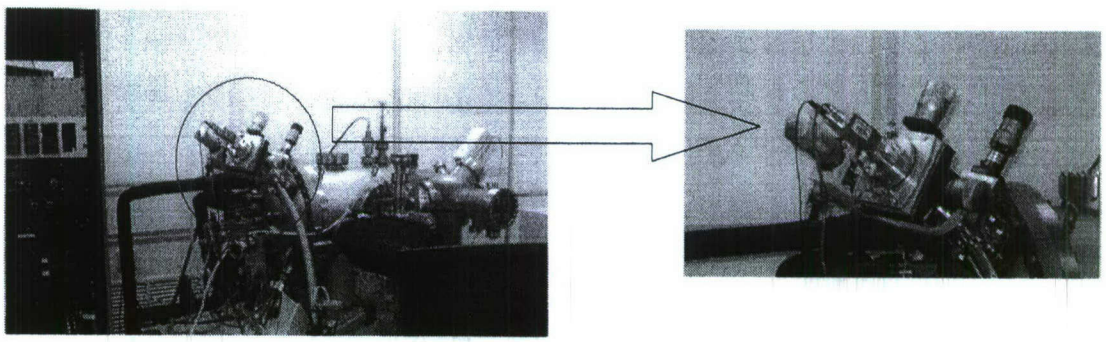

Fig. 2. Digital photo of RHEED-TRAXS tool installed on Riber 3200 growth chamber.