談話室

The 7 th Oxford Conference on Microscopy of Semiconducting Materials

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The 7 th Oxford conference on Microscopy of Semiconducting Materials was held at the University of Oxford from March 25-28, 1991. The meeting was organised by the Institute of Physics Electron Microscopy and Analysis Group and the Royal Microscopic Society, with endorsement by the Materials Research Society. The Co-Chairmen were Dr. A G Cullis (RSRE) and Dr. N J Long (Oxford University). Presentations consisted of 10 oral sessions with a total of 65 papers and 3 poster sessions with a total of 109 papers. The majority of presenters were from European universities and institutions. In the oral sessions about 50 presentations were from Europe, about 10 from USA and 4 from Japan. Table 1 shows the breakdown of the oral sessions (figure in brackets shows number of papers from Japan):

Table 1

	Session	Presentations
1	High resolution EM	5 (1)
2	Microanalysis	6 (0)
3	Dislocations and grain-boundaries	6 (1)
4	Silicides and contacts	6 (0)
5	Processed silicon	7 (0)
6	GaAs	4 (0)
7	X-ray studies	4 (0)
8	Epitaxy I, II, III	12 (1)
9	Quantum wells and superlattices	9 (1)
10	Advanced SEM techniques	6 (0)

The meeting was intended to cover recent advances in characterization of semiconductors by Electron Microscopy (TEM, SEM etc.) and related techniques (EDX, EELS, STM etc.) in addition to advances in the materials themselves as determined by these methods.

The session on High Resolution miscroscopy dealt with advances in the characterization of compound semiconductors using these techniques. In particular, it concentrated on the use of computer simulations in conjunction with HREM to identify the precise atomic arrangement found at e. g. interfaces, surfaces and defects such as dislocations and twins. The materials discussed included III-V and II-VI materials in addition to Si/Ge alloys and superlattices.

Microanalysis covered topics such as EELS, EDX and atomic probe analysis of materials. The use of parallel EELS (PEELS) for elemental mapping in AlGaAs/GaAs systems by use of probes down to 0.2nm was demonstrated. A similar study of GaInAs/InP MQW structures using high-resolution (1.5 nm) EDX mapping in addition to high-resolution TEM was reported. Another presentation dealt with an investigation of Ag/GaAs and Au/GaAs Schottky barriers using field-ion-microscopy and atomic probe microanalysis.

In Dislocations and Grain Boundaries detailed high-resolution analyses were described on grain-boundaries and tilt-boundaries in Si and Ge and the dislocation structure found at such boundaries. In addition, the effect of impurity doping on dislocation dynamics in GaAs and Si, e. g. the pinning of phosphorous on dislocations in silicon crystals, was studied. Also, one presentation reported on exciton-enhanced mobility of dislocation in ZnS by in situ TEM observations.

The Silicides and Contacts session consisted of papers on the characterization of various contact materials to Si and III-V crystals. One technique, Ballistic Electron Emission Microscopy, which is based on STM

and can probe buried interfaces with a lateral resolution of 10 Å, was applied to Au-GaAs contacts. Detailed TEM reports were given on the interface structure in $CoSi_2$ and $TiSi_2$ films on Si and the effect of annealing on the defect structure (stacking faults, microtwins) in the films.

Processed Silicon dealt largely with defects introduced during processing steps in the fabrication of Si IC's, including precipitation of oxygen, copper and iron.

Defects in bulk GaAs was the topic covered by the GaAs session. A variety of experimental techniques such as TEM, STM and Laser Scanning Microscopy were applied to the study of dislocation cell structures, As precipitates, and threading dislocation distribution.

The X Ray Studies session introduced data from relatively new techniques such as Triple Crystal Diffractometry, X-Ray Reflectometry and Crystal-Collimated Double Crystal Diffractometry. These methods were applied to the determination of strain in Ge on Si and the dynamics of misfit dislocations in GaAs on Ge heterostructures.

The largest session of the meeting, Epitaxy, covered many aspects of the growth and characterization of epitaxial layers. Near room temperature growth by MBE was studied for GaAs/GaAs, Si/Si and Ge/Si systems; in all cases a temperature-dependent, limited thickness epitaxial relationship is found. Many papers focussed on the generation of misfit dislocation in mismatched epitaxy. In addition, several papers dealt with atomic ordering in III-V ternary epilayers, including a first report of ordering in MOCVD-grown InGaAs on (001) InP substrates.

Another large session was Quantum Wells and Superlattices. The opening talk introduced the use of Convergent Beam Diffraction to study superlattice structures in plan-view; accurate determination of well thicknesses is possible with this method in addition to evaluation of strain to 1 part in 10^3. A number of papers dealt with strain release in multilayers by defects such as dislocations and twins; such results were given for CdTe/ZnTe SQW's, Ge_xSi_{1-x}/Si heterostructures, InAs/GaAs multilayers and GaAs/InGaAs SLS's. There were also reports on degradation of laser diodes containing multilayer structures.

The final session, Advanced SEM Tehniques, concentrated on SEM-related techniques such Cathodoluminescence, Electron Beam Induced Current (EBIC) and Electron Channelling Contrast in the study of III-V Quantum Well structures and defects in III-V materials and Si.

As an overview, the meeting provided a well balanced coverage of current progress of semiconductor evaluation using electron microscopy and related techniques.

Proceedings of this meeting are to appear as part of the Institute of Physics Conference Series.