

## A Workshop on Two-Dimensional Semiconductor Research Using Synchrotron Radiation:2D(SR)<sup>2</sup>

Douglas Tweet

(NEC Microelectronics Research Laboratories, Tsukuba)

On November 15 and 16, A Workshop on Two Dimensional Semiconductor Research using Synchrotron Radiation: 2D(SR)<sup>2</sup> was held at the Mitsubishi Kasei Tsukuba Creation Center in Tsukuba Science City. The purpose of the workshop was to inform semiconductor scientists about the applicability of SR experimental techniques to problems related to semiconductor surfaces and interfaces.

In their introductory talks, Prof. Y. H. Kao of the State University of New York at Buffalo and Prof. H. Hasegawa of Hokkaido University emphasized issues that were echoed by many subsequent speakers and became the themes for the workshop. They pointed out the need to develop in-situ, time-resolved, dynamical probes for both experimental studies and fabrication process control, as well as microbeam technology that has both high lateral resolution and is capable of depth profiling. They also called for increased cooperation between crystal growers, those who determine the structure, and people who measure device properties. As a semiconductor scientist outside of the SR community, Prof. Hasegawa stressed the increasing importance of understanding and controlling surface and interface properties, an area in which SR is well-positioned to make significant contributions. He also called specifically for more work to understand and eliminate Fermi-level pinning.

With that as a beginning, the workshop was off and running with talks covering a wide variety of

techniques and experimental systems. Some of the papers that stood out to me most were in-situ diffraction of the growing GaAs surface using organometallic vapor phase epitaxy (OMVPE) (Paul Fuoss, AT&T Bell Labs), SR-assisted low temperature epitaxial growth and cleaning of Si (Y. Nara, Fujitsu), photoemission spectroscopy and microscopy (P. Pianetta, SLAC, and G. Margaritondo, Lausanne), and the development of a soft x-ray microbeam for three-dimensional chemical state analysis (K. Ninomiya, Hitachi). In addition, I. Lindau of MAX-Lab in Sweden impressively showed what can be done with an optimized beamline.

At the banquet Prof. J. Chikawa gave an entertaining overview of the past, present, and future of crystal growth, with a dash of humor and philosophy. And after the final talk Prof. T. Matsushita of KEK wrapped up with personal remarks on how this workshop was rapidly organized. In spite of being put together so quickly, the workshop was certainly successful in bringing together scientists from a variety of places. Six countries, fifteen companies, and over ten universities were represented, and there was much interaction during, between, and after talks. Only time will tell if the workshop succeeded in getting the semiconductor industry more interested in SR, but I personally found it very enjoyable and stimulating.