Electronic Materials Conference Held in Newark

The second International Conference on Electronic Materials (ICEM-90) was held in Newark, New Jersey, September 17-19, 1990, under the co-sponsorship of the Materials Research Society, the European Materials Research Society, and the Japan Society of Applied Physics.

The conference focused on emerging electronic materials impacting the electronics industry in the 21st century. Four topical areas were covered: materials for high T_c superconducting electronics, materials for optoelectronics, advanced thin film technology, and diamond for electronic and optical applications. To maximize cross-disciplinary interactions no parallel sessions were held, and poster sessions were interspersed between oral sessions. H. Watanabe of NEC Corporation gave the after-banquet talk, "Toward a Single-Atom-Manipulated Materials Science."

The conference was chaired by R.P.H. Chang, Northwestern University, Takuo Sugano, University of Tokyo, and Van Tran Nguyen, CNET CNS.

Below are highlights from two of the four sessions. For more detailed information on the conference, contact the Materials Research Society for the proceedings.

Optoelectronics

T. Kobayashi reported on some of the recent progress in the physics of nonlinear optical behavior in organic materials such as polydiacetylene and polythiophene. Such materials are potentially useful for future ultrafast all-optical switching devices. The talk was a refreshing reminder of the long-term potential of materials other than semiconductors, while at the same time showing that much of the basic physics is common to these different fields.

J. Völkl gave an overview of the importance of and issues in substrate materials for optoelectronics, such as GaAs and InP. Some of the issues still relate to the purity of the starting elements. One goal is to make semi-insulating InP without having to dope it with Fe. Recent research has achieved promising results. Uniformity of substrate doping and dislocation density are still very important issues for devices, affecting both yield and performance. Völkl emphasized that achieving significant progress in the difficult task of growing improved substrate materials will require more extensive cooperation in the growth community.

U. Koren discussed the sophisticated growth and fabrication techniques used in making photonic integrated circuits. Such circuits consist of integrated combinations of semiconductor lasers, photodetectors, waveguides, modulators, amplifiers, and filters. This kind of integration will be important for improving the functionality and performance of optoelectronic systems as well as reducing cost.

Koren described one particular process starting with the growth of a complex layer structure including quantum well layers. This single structure can subsequently be processed by a combination of techniques to make several different components together in the same structure. One example circuit contained four different tunable lasers combined through waveguide couplers into an amplifier section to give a wavelength-division-multiplexed optical transmitter.

Other highlights included the remarkable technique reported by E. Yablonovitch of Bellcore in which entire semiconductor films of micron thickness can be floated off their growth substrate and bonded to a variety of other substrates. This may be an important technology for new kinds of hybrid optoelectronic integration.

L.M.F. Chirovsky of AT&T Bell Laboratories showed 64 × 32 arrays of symmetric self-electrooptic effect devices for experimental dimensionally parallel optical switching and processing systems. These devices require a sophisticated layered semiconductor structure that includes both quantum wells and an integral multilayer dielectric mirror grown by molecular beam epitaxy.

J.M. Halbout of IBM discussed silicon-based optoelectronics, including waveguides and detectors for optical receivers. Many demonstrations, including dielectric waveguides, grating couplers, and Si/Ge superlattice photodetectors, are promising for future optoelectronic integration with silicon.

Other papers covered novel epitaxial growth technologies, techniques for k-doping in very thin sheets for novel electronic and optoelectronic devices, growth of GaAs light-emitting diodes on silicon substrates, and successful optoelectronic modulator structures using strained layers.

High T_c Superconducting Electronics

Wayne Cooke (Los Alamos National Laboratory) presented results on microwave properties of thin films of the cuprate superconductor thin films grown by *in-situ* laser deposition and sputtering as well as *ex-situ* processed films. The microwave properties and fabrication of microwave devices was also the focus of the talk by Findikoglu et al. They discussed the fabrication, testing, and theory of meanderline microwave resonators. These meanderline resonators were fabricated from laser deposited or sputter YBCO films.

A. Inam (Bellcore) gave an excellent overview of the structure and transport properties of *in-situ* pulsed-laser-deposited Y-Ba-Cu-O thin films. This invited talk focused primarily on the growth and characterization of epitaxial heterostructures for junction applications. In addition to this, Inam also discussed the microwave properties of YBCO thin films. Other papers addressed other thin film deposition techniques such as MOCVD, plasma enhanced MOCVD, and spray pyrolysis.

J. Geerk (KFK, Karlsruhe, Germany) outlined the dc magnetron deposition technique, including the inverted cylindrical magnetron sputtering pioneered at Karlsruhe. He presented results from a variety of tunneling transport experiments. M. Siegal et al. from AT&T Bell Laboratories reported the results of systematic variations in the cationic stoichiometry and the growth conditions on the structural and electrical transport properties of *ex-situ* processed electron beam deposited YBCO thin films. Asano et al. from NTT (Japan) reported the growth of $YAlO_3$ single crystals which had better microwave properties compared to $LaAlO_3$.

All the oral sessions were followed by a joint poster session. The overall quality of the poster presentations was excellent. There were some interesting posters aimed at the growth of HTSC films on metallic or semiconductor substrates. It was clear, however, that the crystalline quality and electrical properties of such films is still well below that obtained by laser deposition or sputtering onto single crystalline oxide substrates. □

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