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WORKSHOP ON THE PHYSICS AND MODELING OF SUBMICRON
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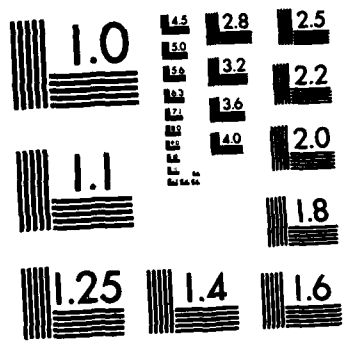
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WORKSHOP ON THE PHYSICS AND MODELING
OF SUBMICRON STRUCTURES

University of Illinois, Allerton House
June 28-30, 1982

Final Report

K. Hess

October 1983

ARO MIPR 46-82

Coordinated Science Laboratory
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Submicron Structures Microelectronics		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) → A Workshop on the Physics and Modeling of Submicron Structures has been held. The results and lectures of the Workshop are briefly described.		

→ The purpose of this workshop was to increase and discuss the understanding of material and transport properties on the submicron scale and to stimulate interest among distinguished scientists in this challenging field. The number and standing of participating scientists showed clearly the growing interest in this area, which was further enhanced by the meeting.

Three major areas concerning submicron semiconductor structures were discussed:

- (i) Many papers were devoted to Monte Carlo simulations of "ballistic transport," velocity overshoot, and the simulation of device structures such as planar doped barriers (Ferry, Grubin, Littlejohn, the Cornell group, Leburton, and others). There was a general consensus that very high (ballistic) velocities, approaching 10^8 cm/s, can only be achieved if electrons are injected at higher energies. It also became clear that collisions play an important role even at very short times and that transport is never entirely ballistic (collision free) even down to device length of 100 \AA in semiconductors such as GaAs and InP. Another important finding was that the supply voltages must be low (below the corresponding energies of the satellite valleys) to achieve high velocities. A discussion including details (intracollisional field effect, etc.) was given by Ferry. There were also substantial discussions of the role of contacts, electron-electron scattering, electron plasmon interaction and diffusion. All these effects are detrimental for ultrahigh speed.
- (ii) Many contributions were devoted to superlattices and semiconductor heterostructure layers. These contributions demonstrated clearly the high potential of these structures, which can easily be made ultrasmall

in one direction. Holonyak pointed out the opportunities of quantum well lasers, Döhler discussed the special properties of doping superlattices, Maradudin's lecture treated phonons in confined geometries, and Capasso dealt with superlattice avalanche photodiodes. It is clear from these talks that the variability of the boundary conditions in these structures opens a new area of semiconductor electronics. This was also stressed by Bardeen in his introductory talk and by G. J. Iafrate and Bruce McCombe in their overviews.

(iii) The third major area discussed was the modelling of submicron devices. Several papers treated this subject in a more general way. Of special interest were the papers on the high mobility transistor (Linh and Delagebeaudeuf) which demonstrated ultrahigh speeds and the review and results of Grubin et al. on modelling considerations for VLSI devices.

The rest of the papers covered a wide area, ranging from a proposal of a terahertz oscillator to the design of current VLSI structures. A list of speakers and participants is attached. The manuscripts will be published by Plenum Press as the proceedings volume of the workshop.



A-1

Speakers:

H. U. Baranger and J. W. Wilkins
John Bardeen
J. R. Barker
Herbert Bennett
Robert Buhrman
F. Capasso
Pallab Chatterjee
Steven S. Cherensky and Peter A. Blakey
Gottfried Döhler
L. Eastman
R. Fauquembergue, M. Pernisek, and E. Constant
David K. Ferry
D. K. Ferry, R. O. Grondin, R. K. Reich, H. L. Grubin, and G. J. Iafrate
D. Greene
Harold L. Grubin
Karl Hess
Nick Holonyak, Jr.
Gerald J. Iafrate
Johnson Lee, M. O. Vassell, and H. Lockwood
Nguyen T. Linh and D. Delagebeaudeuf
A. A. Maradudin
Bruce McCombe
M. W. Muller, P. Roblin, and D. L. Rode
D. F. Nelson
J. B. Socha, F. A. Buot, and J. A. Krumhansl
R. J. Trew, R. Sultan, M. A. Littlejohn, and J. R. Hauser
D. C. Tsui
T. Wang, J. P. Leburton, and K. Hess
T. H. Windhorn, L. W. Cook, T. J. Roth, and G. E. Stillman
J. S. Ziegler

Panel Discussion Members:

L. Anderson
D. Bimberg
J. R. Brews
L. Cooper
J. Frey
G. Gamota
E. Gornik
M. Littlejohn
M. Nathan
P. Price
D. C. Tsui
H. Wittmann

Preprints of Papers Presented:

Attached

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