

Authors

Narasipur G. Anantha

Components Division, East Fishkill, New York

Dr. Anantha received the B. Sc. (Honors) in Physics in 1954 from Mysore University, India; a diploma in 1958 from the Indian Institute of Science; the S.M. in Electrical Engineering in 1960 from the Massachusetts Institute of Technology; and the Ph.D. in Applied Physics in 1965 from Harvard University. He joined IBM in 1967 and is currently a Development Engineer in the laboratory at East Fishkill, where his primary areas of interest include metal-semiconductor devices, field-effect devices, and integrated circuits. He is a member of Sigma Xi and the IEEE.

Kanu G. Ashar

Components Division, East Fishkill, New York

Dr. Ashar is manager of a device technology group at the East Fishkill Laboratory. He received his B.E. from the University of Baroda (India) in 1954, M.S.E.E. from the University of Michigan in 1958, and Ph.D. from Syracuse University in 1966, all in Electrical Engineering. He worked on the construction of power stations and transmission lines with the Bombay Government and on electrical equipment with Crompton Parkinson Ltd. of Bombay (1954 to 1957). He joined the IBM Systems Development Division in 1958 to work on reliability problems of circuits and systems. Since 1961 he has been with the Components Division engaged in activities related to high-performance circuits and exploratory devices. He was awarded the IBM Ph.D. Fellowship (1964-1966). He is a member of the IEEE.

Joseph J. Chang

Components Division, Burlington, Vermont

Dr. Chang is a Senior Engineer and manager of exploratory solid state device development at the laboratory in Burlington. He joined IBM in 1966 as an Advisory Engineer in East Fishkill, where he was in charge of the semiconductor support device development for a memory project. In 1968 he became the manager of a semiconductor device development department in support of Components Division memory development programs, and in 1969 he assumed his present position. He received the B.S. in Electrical Engineering, the M.S. and Ph.D. in 1957 and 1961, respectively, from Purdue University. From 1957 to 1959 he was with the Remington Rand Univac, and from 1961 to 1964 he was on the technical staff of the Bell Telephone Laboratories working on semiconductor devices. He was a United Nations physics and electronics expert assigned to Chiao Tung University in Taiwan, China from 1964 to 1965, where he also served as a visiting professor, and was a project engineer at Bendix Research Laboratory from 1965 to 1966. Dr. Chang is a member of Sigma Xi, the American Physical Society, the American Association for the Advancement of Science and is a senior member of the IEEE.

Te-Long Chiu

Components Division, East Fishkill, New York

Dr. Chiu is a Staff Engineer in the exploratory devices group at the East Fishkill Laboratory. He came to the United States in 1963 and received the M.S. and Ph.D. degrees from the University of Illinois in 1964 and 1968, respectively. He has been with IBM since 1968.

Billy L. Crowder

Thomas J. Watson Research Center, Yorktown Heights, New York

Dr. Crowder is currently a member of the ion implantation group at the Research Center. He has been with IBM since 1964. He received a B.S. in Chemistry from Duke University in 1958 and a Ph.D. in Physical Chemistry from Cornell University in 1963. Dr. Crowder was a staff member of the Research Center of Union Carbide Nuclear Company from 1962 to 1964. Since joining IBM, his research interests have included luminescence and electrical conductivity of wide-band-gap II-VI compounds, point defects in II-VI compounds, and studies associated with ion implantation doping of semiconductors, particularly silicon. Dr. Crowder is a member of the American Chemical Society, the Electrochemical Society, AAAS and Sigma Xi.

David DeWitt

Components Division, East Fishkill, New York

David DeWitt is an IBM Fellow working on logic technology. He has been with IBM since 1956. He was educated at Columbia University and received an M.S. in E.E. in 1938. He taught at Columbia, 1938-1939, and was with the Radio Receptor Co. from 1939 to 1956. At Radio Receptor he worked on aviation navigation; communications and radar equipment, receiving a Certificate of Appreciation from the War Department for his work during World War II. He directed the company's pioneer work in semiconductor device development and manufacture. Mr. DeWitt is co-author of three widely used texts on semiconductor devices and was a Visiting Professor at the University of California, Berkeley in 1969. He is a member of the American Physical Society, a Fellow of the IEEE, a registered Professional Engineer and is currently Editor of *IEEE Spectrum*.

David M. Ellis

University of Vermont, Burlington, Vermont

Dr. Ellis is an Assistant Professor of Electrical Engineering at the University of Vermont, where he has taught since 1968. He received his B.S. in Engineering Science from the Pennsylvania State University in 1959. After graduation he joined the Burroughs Corp., where he was concerned with computer memory techniques until 1963 when he returned to school. He received the M.S. and Ph.D. degrees in Electrical Engineering from the University of Washington in 1965 and 1968, respectively. Dr. Ellis is a member of the IEEE and Sigma Xi.

Hitendra Nath Ghosh

Components Division, East Fishkill, New York

Dr. Ghosh received his B.Tech. (with honors) from the Indian Institute of Technology, Kharagpur, India, in 1958. He joined the University of Illinois as a Fellow in electrical engineering and received the M.S. and Ph.D. in 1959 and 1962 respectively.

He has been a teaching fellow of the University of Illinois and a student associate of Argonne National Laboratory in Illinois. He joined IBM in 1962 and was promoted to Senior Engineer in 1968. Dr. Ghosh has worked in device, circuit, and process modeling, design, and characterization. At present he is a manager of a process control and evaluation group. He has been an Adjunct Professor of Electrical Engineering at Syracuse University and is a member of IEEE, AAAS, and Pi Mu Epsilon.

Michael Hatzakis

Thomas J. Watson Research Center, Yorktown Heights, New York

When Mr. Hatzakis joined IBM at the Research Center in 1961, he began work in the electron beam group, where he participated in the development of the electron-beam recorder for a photostore project and a large-scale integration program. He also developed techniques that make it possible to fabricate high-resolution structures using electron beams and electron sensitive materials. He is currently working on electron-beam fabrication of submicron transistors, acoustic surface wave transducers and processing of thin magnetic films. Mr Hatzakis received his B.S. and M.S. degrees in Electrical Engineering from New York University in 1964 and 1967, respectively.

Walter J. Kleinfelder

Components Division, East Fishkill, New York

Dr. Kleinfelder received his B.S. in Electrical Engineering from Rensselaer Polytechnic Institute in 1961, his M.S. in Electrical Engineering in 1964 from Syracuse University and his Ph.D. in Electrical Engineering in 1967 from Stanford University. He joined the IBM Components Division at Poughkeepsie in 1961 and has worked in various areas of exploratory device and circuit technology since that time. Dr. Kleinfelder is currently manager of manufacturing research process development for the Components Division. He received the IBM Resident Study Fellowship in 1964 for study at Stanford University. He is a member of IEEE, Eta Kappa Nu, Tau Beta Pi and Sigma Xi.

Steven Magdo

Components Division, East Fishkill, New York

Dr. Magdo is an Advisory Engineer in the Exploratory Devices group at the Components Development Laboratory in East Fishkill where he has worked on ultra-high-speed semiconductor circuits and is currently engaged in the development of semiconductor optical devices. He has been with IBM since 1967. His education includes a Diplom-Ingenieur degree in Electrical and Mechanical Engineering from the Technical University of Budapest, 1950; an M.S. in 1962 and a Ph.D. in Electrical Engineering in 1964, both from Lehigh University. From 1950 to 1956 he was employed at the United Incandescent Lamp and Electrical Company, Budapest, where he worked on electron tube development and application. From 1952 to 1956 he did research in electron tube theory for the Hungarian Academy of Sciences as a fellow. He was on the technical staff of the Bell Telephone Laboratories in Allentown, Pennsylvania, from 1957 to 1965, where he worked on electron tube development. From 1965 to 1967 he was employed at the Semiconductor Products Department and Avionics Control Department of the General Electric Company in Syracuse, New York and Johnson City, New York, respectively. In the Semiconductor Products Department he worked on GaAs laser and light emitting diode development and application. He pioneered in development on the GaAs laser for automobile safety. In the Avionics Control Department he worked on Nd:YAG laser development. Dr. Magdo is a member of IEEE.

Avtar S. Oberai

Components Division, East Fishkill, New York

Dr. Oberai is a Senior Engineer and manager of an advanced technology group at the laboratory in East Fishkill. He has been with IBM since 1967. His education includes a Bachelor of Engineering degree, 1954, in Telecommunication Engineering from the University of Poona, India, and a Ph.D. in Electronics in 1964 from the Imperial College of Science and Technology, University of London, England. Dr. Oberai was an instructor at the University of Poona from 1955 to 1956. He was a research and development engineer at Pye Telecommunication, London, from 1957 to 1959 and was a senior member of the technical staff at RCA Victor Research Laboratories in Montreal from 1955 to 1956. Dr. Oberai is a member of the IEEE.

James Reuter

Cogar Corporation, Technology Division, Wappingers Falls, New York

Mr. Reuter is an engineer in the materials and processes department at Cogar, where he is currently engaged in development of processes for bipolar and N-channel MOS memory arrays. From 1958 to 1963 he was engaged in basic studies of ionization in flame at Aero Chem Research Laboratories, Princeton, New Jersey, and from 1963 to 1967 he was involved in photochemical studies of fluorinated polymers at the Thiokol Chemical Co. He has also worked on As-Si, B-Si and P-Si solid systems at the IBM Components Division Laboratory in East Fishkill, New York. Mr. Reuter attended Rutgers University.

Albert E. Ruehli

Components Division, Burlington, Vermont

Mr. Ruehli joined IBM at the Zürich Research Laboratory in 1958, where he worked on thin film memories. In 1963 he transferred to the Thomas J. Watson Research Center to work in semiconductor circuits and devices, and in 1966 he moved to Burlington, where he is with the mathematical and engineering group at the components Division Laboratory. He received his Telecommunication Engineering degree in 1963 from Abend Technikum Zürich. From 1964 to 1966 he attended graduate courses given by Syracuse University in Poughkeepsie, New York and, at present, he is completing his studies for the Ph.D. in Electrical Engineering at the University of Vermont. Mr. Ruehli is a member of the IEEE.

Jagtar S. Sandhu

Cogar Corporation, Technology Division, Wappingers Falls, New York

Dr. Sandhu is the manager of the materials and processes department at Cogar, where he is responsible for process development for MOS and bipolar memory arrays. As the manager of a thermodynamics and kinetic studies group at the IBM Components Division Laboratory in East Fishkill, New York, he was previously involved in studies on Si-As, Si-P, Si-B and doped oxide systems; he worked at IBM from 1966 to 1969. His education includes the B.S., 1959, and M.S., 1960, from Punjab University, India, and the Ph.D. in Chemistry, 1966, from the University of Southern California. He was a Research Associate and Instructor at Southern California during the academic year 1965-66. Dr. Sandhu is a member of the Electrochemical Society, Sigma Xi and Phi Lambda Upsilon and is a Fellow of the American Institute of Chemists.

Chiu H. Ting

Components Division, East Fishkill, New York

Dr. Ting is an Advisory Engineer in the logic products group at the Components Division Laboratory in East Fishkill. He joined IBM in 1961 at the Systems Development Division Laboratory in San Jose, California, where he worked on advanced recording techniques using electron beams. At San Jose he participated in the development of the electron beam recorder of the trillion-bit photodigital store system for the Atomic Energy Commission. From 1966 to 1968 he was an IBM resident graduate fellow at the Solid State Laboratory of Stanford University, where he did research on impurity diffusion in compound semiconductors. He came to the East Fishkill Laboratory in 1968 and has worked since then on advanced integrated circuits and microminiaturization. His degrees are all in Electrical Engineering: the B.S. from the University of California at Berkeley in 1960, the M.S. and Ph.D. from Stanford University in 1964 and 1968, respectively. Dr. Ting is a member of the IEEE, the American Physical Society and Sigma Xi.

Madhukar B. Vora

Components Division, East Fishkill, New York

Mr. Vora is manager of the exploratory device group at the Components Division Laboratory in East Fishkill, where he is currently engaged in the development of bipolar and MOS inte-

grated circuits. He has been with IBM since 1961. He received his B.S. in Electrical Engineering from the Government Engineering College in Jabalpur, India and an M.S. in Electrical Engineering from Worcester Polytechnic Institute, Worcester, Massachusetts. Mr. Vora is a member of the IEEE.

James F. Ziegler

Thomas J. Watson Research Center, Yorktown Heights, New York

Since joining IBM in 1967 Dr. Ziegler has pursued research interests in semiconductor metal alloys, germanium transistor technology, nuclear channeling studies of impurities in semiconductors, and high-energy ion-implantation of impurities in semiconductors. Previously, he was a Research Staff Member in the Electron Accelerator Laboratory at Yale University, where he worked on the quantum-mechanical relativistic theory of inelastic scattering of electrons from nuclei. He received the B.S. in Industrial Engineering in 1957, the M.S. in Physics in 1965 and the Ph.D. in Physics in 1967, all from Yale. Dr. Ziegler is the author of the book, "Inelastic Electron Scattering from Nuclei."