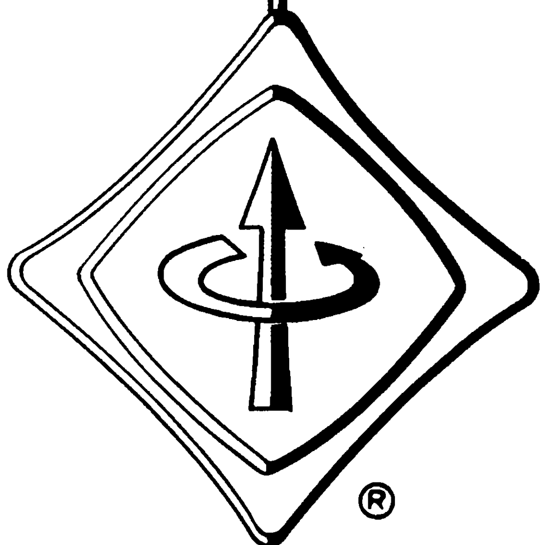

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Jim Black (left) receives the award from Harry Schafft.

Special Recognition Award

of the

International Reliability Physics Symposium

to

James R. Black

April 1, 1992, San Diego, California

The Board of Directors of the 1992 International Reliability Physics Symposium elected James R. Black to receive the Special Recognition Award of the Symposium in honor and celebration of his pioneering research in electromigration which has had a profound and long-lasting effect on the semiconductor community and its researchers.

Those who are involved in electromigration studies and those who are otherwise concerned about what remains a critically important failure mechanism of metallization interconnects stand on his shoulders. For it is his name that is attached to the empirical equation he introduced that relates the median time to failure of electromigration, t_{50} to the mechanism drivers of current density, J, and metallization temperature, T:

$$t_{50} = \frac{A}{J^n} \exp\,(Q_A/kT)$$

where A is a material constant, n is a constant to be determined, and Q_A is the activation of the electromigration mechanism.

His first paper on electromigration was published as an RADC Technical Report 68-243 in October 1968 entitled *''Metallization Failures in Integrated Circuits''*. His first professional journal publication appeared in the Proceedings of IEEE September 1969 entitled, *''Electromigration Failure Modes in Aluminum Metallization for Semiconductor Devices"*. This was closely followed by a chapter in an Electrochemical Society Book on "Ohmic Contacts to Semiconductors." In this chapter he described, ''Etch Pit Formation in Silicon at Aluminum Silicon Contacts because of Transport of Silicon by Momentum Exchange with Conducting Electrons''. This experimental study was summarized in a classic paper in IRPS 1978 entitled, *''Electromigration of Al-Si Alloy Films''* that included the famous Black's Equation.

A second IRPS paper was given in 1982 entitled, *''Current Limitations of Thin Film Conductors''* which established for the first time the Mil-Std limits of $2x10^5$ A/cm^2 for electromigration design limits.

Mr. Black received a B.A. degree from Carleton College in 1942 with a major in chemistry and graduated from the Signal Corp Electronics and Microwave Schools at the Illinois Institute of Technology and the University of Chicago. He was employed at the Radio Research Laboratory at Harvard during WWII and later became an assistant professor of electrical engineering at the University of Michigan where he was involved in microwave electron tube research.

In 1959 he joined Motorola as manager of their Solid State Systems Division Integrated Electronics Laboratory. In 1964 he transferred to the Motorola Semiconductor Products Division as Manager of the Materials Research Laboratory and the Semiconductor Analytical Laboratory.

Jim Black has been a regular attendee of IRPS for many years, giving tutorials, participating in panel discussions, and keeping authors on their toes with questions from the floor. Throughout his career, he has been a patient, unpretentious, and supportive mentor to many of his fellow workers in the field of Reliability Physics. He was one of the early solid state scientists that brought a materials discipline to an industry run by electrical engineers. Mr. Black has now retired from Motorola but still actively attends IRPS meetings when he can. It is fitting the IRPS honor such a devoted researcher.

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