John Wauchope Matthews

John Matthews was born in Johannesburg on 31st March 1932. He was the eldest son of Armour Hamilton Matthews and Margaret Constance Matthews. He attended St. Johns College, Houghton in Johannesburg from January 1940 to July 1950. He wrote the Examination of the Joint Matriculation Board in December 1949 and achieved a first class pass.

In 1951, John Matthews entered the Faculty of Science at the University of the Witwatersrand in Johannesburg. In 1954, he obtained the degree of Bachelor of Science in Chemistry and Physics, and two years later he obtained a first class pass in the Honours Examination in Physics. On the 1st August 1956, John Matthews was appointed Laboratory Assistant in the Department of Physics and given the responsibility of the installation and supervision of the second transmission electron microscope (TEM) to be purchased in Southern Africa. It was, however, the first "high resolution" TEM (Siemens Elmiskop 1) and the first TEM to be installed in a university in Southern Africa. The instrument was installed in the Biology Block at the Main Campus (Milner Park) of the University. John Matthews was largely responsible for the maintenance of the microscope while being encouraged to create an interest in electron microscopy throughout the University as well as develop his own field of scientific research. The presence of Dr J.T. Fourie (Dr H.G.F. Wilsdorf's successor) at the Council for Scientific and Industrial Research (CSIR) in Pretoria with his experience of electron microscopy of thin metal foils (the first TEM was installed at the CSIR), and that of Dr J.H. van der Merwe at the University of Pretoria, a pioneer in the theory of epitaxy, induced John Matthews to work on the electron microscopy of epitaxial deposition. From January-July 1957, John Matthews was at the Cavendish Laboratory at the University of Cambridge and worked under Dr PB Hirsch and Dr VE Cosslett, before moving on to the Electron Microscope Department at Siemens and Halske A.C., in Berlin until the end of that year. He soon established a reputation for undertaking clean and elegant experiments with penetrating discussion. On his return to South Africa, he joined an informal group in the Physics Department of Paul Jackson who was a contemporary of John's, Dave Allison, Rob Caveney, Jim Murphy, and Ewald Wessels. Prof F.C. Frank visited the group while John was still a PhD student. John Matthews was speaking of the relation between misfit dislocations and moiré fringes. Prof Frank insisted that they were the same. Quite undeterred by the authority of the inventor of the theory, John explained the difference. In 1962, John Matthews presented a thesis entitled "An electron microscopical study of defects in evaporated single-crystal films" to the Department of Physics at the University of the Witwatersrand and subsequently he received his PhD at the graduation ceremony held on 23rd March 1963. By this time John Matthews was a Lecturer in Physics.

Some of John Matthews' main interests at this time were in the formation of defects by the coalescence of growth nuclei and in the use of moiré fringes to study epitaxial misfits. The conditions for ood epitaxial growth seemed to include rapid growth and the presence of contamination, which he reasoned into a need for many initial nuclei. He also studied the generation of defects when interdiffusion occurred between the substrate and deposit on annealing, and developed a special interest in the glide and climb of misfit dislocations. Years later, this led to a patent on the production of dislocation-free deposits by encouraging the dislocations present in the deposit to migrate into the interface. Sometimes the misfit dislocations dissociate to yield partial dislocations which induce transformations in the deposit.

John Matthews' principal collaborator in Johannesburg at this time was Dr. D.L. Allinson. He also had close contact with the group at the University of Virginia in Charlottesville, where Prof Heinz and Doris Wilsdorf were now settled. He held a post-doctoral fellowship from January 1964 to January 1966 with Prof Doris Kulmann-Wilsdorf in the Division of Engineering and Applied Science at the University of Virginia. He worked closely with Prof W.A. Jesser at the same University, each making long visits to the other's laboratory. Research involved the mechanical properties of thin films, including the spontaneous cracking

when both substrate and deposit were brittle. For 15 months in 1966/1967, Prof Jesser visited the University of the Witwatersrand where he and John Matthews investigated mechanisms of the epitaxial growth of gold, silver and copper individually deposited in UHV onto twelve vacuum-cleaved alkali halides. They developed models for the pseudomorphic epitaxial growth and misfit accommodation, by misfit dislocations and homogeneous elastic strain, from electron microscopy and diffraction of the epitaxial bicrystals of fcc metals. The epitaxial layers were observed to copy the lattice constants and in some cases the crystal structure of the substrate. These observations were the first of their kind and provided the pioneering work that is still quoted in the literature. In recognition of the calibre of his work, in 1968, the University promoted him from Senior Lecturer, a position that he had held since January 1965, to a Readership in Electron Microscopy and Director of the Electron Microscope Unit. He was appointed to be the representative for South Africa by the Organizing Committee of the 1969 International Conference on Thin Films held in Boston, Massachusetts from 28th April to 2nd May 1969.

The American connection led John to increasingly close collaboration with the IBM Watson Research Center of the IBM Corporation in Yorktown Heights, New York. Finally, in January 1970, John Matthews joined their staff as Head, Thin Film Research. His closest colleagues there were P. Chadhari and S. Mader. During a visit to the Cavendish Laboratory, he worked on the misfit between flakes of strongly preferred "coincidence" orientations which led to the quite unexpected observation of the accommodation of the lattice strain between two orthorhombic flakes by a crossed grid of screw dislocations of opposite helicies. Always keen to exploit experimental techniques, John Matthews turned part of his attention to the systematic observation of dislocations in synthetic garnets in polarized light. He was joined by E. Klokholm and T.S. Plaskett. He also illustrated the theory of epitaxy by using rafts of bubbles of two sizes. It was at IBM that Matthews, Blakeslee and Mader developed the technique of driving dislocations from a deposit into the interface. Through his work and his internationally recognized authority on epitaxial growth of thin films, John Matthews laid the foundations for the production of multilayered electronic materials.

John Matthews was an overseas fellow of Churchill College, Cambridge, and a member of the Audubon Society and the Conservation Advisory Council of Yorktown.

John Matthews married Valarie Anne Bouchers on 18th August 1961. They had four children. Three were born in Johannesburg: Peter John Matthews born 30th May 1962, David John Matthews born 9 January 1967, Francis Jane Matthews born 9th April 1969. Anne Elizabeth Matthews was born in Charlottesville 4th June 1964.

John Matthews lived in Ossining, New York until his death on 20th May 1977 at the Memorial Sloane Kettering Cancer Center in New York City at the age of 45 years of Hodgkin's Disease. Throughout his long illness, he never allowed it to diminish his scientific productivity.

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John Matthews Memorial Lectures: The first of these annual lectures was given at the conference of the Electron Microscopy Society of Southern Africa held at the CSIR Conference Centre in Pretoria on 4th December 1978 by Professor FRN Nabarro ("The scientific work of John Matthews", Proceedings of the Electron Microscopy Society of Southern Africa, Volume 8, pp. 1-2, 1978). Professor Nabarro had been the Head of the Department of Physics at the University of the Witwatersrand throughout John's academic life, an active supporter of John and his work, and the driving force for the acquisition of an electron microscope at the University. The lecture was attended by both John's widow, Valerie, and his mother, Margaret. This and subsequent lectures have been funded though the generosity of John's family and friends, through the continued financial support from the Foundation for Research Development, now called the National Research Foundation, and the Microscopy Society of Southern Africa.

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MJ Witcomb 27 January 2005