Scanning Probe Microscopy from Technology to Biology

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Scanning Probe Microscopes have become essential tools for nanotechnology. We will discuss the development of this field from its infancy. The first part of the talk will focus on the speaker's early experiences driving the AFM technology from the first published experiments toward fully hardened instruments for use in manufacturing and development both within and outside IBM. Several key scanning probe technologies evolved in his group as a result of this highly focused effort aimed at getting the technology into use within IBM. The second part of the talk will describe recent projects that the speaker has initiated and driven. They range from an x-ray nanoscope capable of 3-D imaging at the nanoscale to the development of an ultra high speed DNA separation technology which can separate DNA strands at speeds that are 10,000 times faster than current micro fluidic separation technologies. Implications for some these technologies will be discussed.

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H. Kumar Wickramasinghe, Ph.D., is a member of the National Academy of Engineering and respected pioneer in nanotechnology. Prior to joining UC Irvine, Wickramasinghe managed nanoscience and technology research at IBM's Almaden Research Center in San Jose, Caliornia.

Prof. Wickramasinghe received a Ph.D. from the University of London in Electrical Engineering in 1974, and a B.Sc. from the same institution in 1970. Following a post-doctoral appointment at Stanford University, he joined the faculty in the Electrical Engineering Deparment at University Colege London in 1978.

In 1984, Wickramasinghe moved to the IBM Research at the T. J. Watson Research Center in Yorktown Heights, N.Y. where he was manager of physical measurements and chief scientist, manufacturing research. He led the team that developed atomic force microscopes (AFMs) into fully hardened instruments that are used both within IBM and world-wide. Holding 80 patents, some of his most significant inventions and contributions to the nano field include the development of the vibrating mode atomic force microscope (AFM), the magnetic force microscope, the electrostatic force microscope, the Kelvin probe force microscope, the scanning thermal microscope, and the apertureless near-field optical microscope. Most of these scanning probe microscopes are standard instruments used today for nano-scale characterization.

In 2000, he was appointed IBM Fellow - the company's highest technical honor- by Lou Gerstner, Chairman and CEO of IBM. In 2001, Wickramasinghe moved to IBM Almaden Research Center to lead the development of technology aimed at increasing the data density of magnetic hard-disk drives. He was named senior manager of nanoscale science and technology in 2002. He initiated and led the work on Storage Class Memory; a novel semiconductor memory aimed at replacing mobile disk drives. In 2005, he was made CTO of Science and Technology at Almaden. In 2006, he joined the Henry Samueli School of Engineering at the University of California, Irvine and was named The Henry Samueli Endowed Chair and Professor of Electrical Engineering and Computer Science and Professor of Biomedical Engineering

Wickramasinghe has received several awards including the IEEE Best Paper Award (in the IEEE publication, Group on Sonics and Ultrasonics Transactions) in 1982, the V. K. Zworykin Premium award of the IEE in 1983, and the IEEE Morris E. Leeds Award in 1992. He was named Distinguished Corporate Inventor of

the National Inventors Hall of Fame in 1998 and was chosen to be a Centennial Lecturer for the American Physical Society in 1999. In 2000, Wickramasinghe and Calvin Quate of Stanford U. received the American Physical Soceity's Joseph F. Keithley Award for their "pioneering contributions to nanoscale measurement science through their leadership in the development of a range of nanoscale force microscopes that have had major impact in many areas of physics." His AFM jet device for rapid molecule sorting and delivery was recently named one of the 25 most innovative products of 2006 in the inaugural "MICRO/NANO 25" competition held by the editors of R&D magazine. In 2006 he also received the Scientific American 50 Award for devising a technique for ultrafast DNA sequencing using atomic force microscopes.

Dr. Wickramasinghe is a fellow of the American Physical Society, and the United Kingdom's Institute of Physics, Institution of Electrical Engineers (IEE), the Institute of Electrical and Electronics Engineers (IEEE) and the Royal Microscopical Society.