Dr Alfred Y CHO

Citation

More than thirty years ago, a new crystal growth technology that later revolutionized the semiconductor industry was being developed at the Bell Laboratories in New Jersey. This new technology, Molecular Beam Epitaxy (MBE), allows the growth of compound semiconductor devices with great precision in layered dimensions of sub-nanometers. The brilliant scientist and engineer behind this development was Dr Alfred Y CHO, who is now widely recognized as the "Father of MBE" in the semiconductor world.

In an era when almost all semiconductor devices were made with silicon inherently limited in nature to interact with photons and other properties, Dr Cho combined high-vacuum and ion-beam technologies to develop MBE for the preparation of epitaxial films one atomic layer at a time, with exceptional control at atomic dimensions. He further showed that these films could be the basis of devices with never before realized electrical and optical properties, and demonstrated that MBE could be used to manufacture microwave devices. In 1975, he achieved another breakthrough by demonstrating the first continuous wave laser by MBE at room temperature.

The impact of MBE on fundamental science has been as dramatic as its impact on semiconductor technology: most of the semiconductor lasers used in today's compact disc players and CD-ROM's are manufactured using MBE-grown material, as are high frequency, low noise components in cell phones; the discovery of an entirely new state of electrons, the fractional quantized Hall effect, was made possible as a result of MBE crystal quality. In 1994, Dr Cho and his coworkers demonstrated a fundamentally new type of laser called the Quantum Cascade (QC) Laser.

The semiconductor community quickly recognized the enormous value of MBE technology. By 1985 Dr Cho was elected to both the US National Academy of Science and National Academy of Engineering in recognition of his achievements. In 1993, Dr Cho was presented the National Medal of Science by former US President Clinton, the highest honor bestowed upon US scientists who have made significant contributions to knowledge in their respective fields. He is also a member of the Academia Sinica (Taiwan) and Chinese Academy of Sciences (Beijing).

Dr Cho was born in Beijing, China, and received his high school education in Hong Kong. After graduation from Pui Ching Middle School (a school known for its math and science training and from where Professors Dan Tsui and Shing Tung Yau also graduated), he attended college in the US, taking his BS, MS, and PhD in Electrical Engineering from the University of Illinois at Urbana-Champaign.

While at graduate school, he built vacuum systems and ion beams to study surface physics. After receiving his masters degree and before returning to school for his PhD, Dr Cho

worked on space programs at TRW Corporation where he was involved in building ion-beam engines. Techniques he experimented with in these formative years were used later to build the first practical MBE system.

After receiving his doctorate degree in 1968, he began his research career at Bell Laboratories as a member of the Technical Staff and was promoted to Department Head in 1984. He was named Director of the Materials Processing Research Laboratory in 1987 and in 1990 became Semiconductor Research Vice President.

Trained from an early age in painting and calligraphy, Dr Cho modestly attributes his success in crystal growth to his combined training in Chinese art ("patience, patience, patience") and formal education in engineering.

Dr Cho has authored over 560 technical papers and holds 60 patents related to MBE. He has received numerous awards for his seminal contributions, and is also a Fellow of the IEEE and the American Academy of Arts and Sciences.

Mr Pro-Chancellor, I have the honor to present to you, on behalf of the University, Dr Alfred Y Cho, inventor of Molecular Beam Epitaxy, and recipient of the US National Medal of Science, for the degree of Doctor of Engineering *honoris causa*.

English citation written by Professor Kei May Lau