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ISAMU AKASAKI

1929–2021

Elected in 2008

"For contributions to the development of nitride-based semiconductor materials and optoelectronic devices."

BY HIROSHI AMANO

ISAMU AKASAKI, Special Distinguished Professor of Meijo University, and Distinguished University Professor and emeritus professor of Nagoya University, pioneer of blue LEDs, and Nobel Laureate in Physics, passed away from pneumonia April 1, 2021, at the age of 92.

He was born January 30, 1929, to Suguo and Sumi Akasaki; his father was a Buddhist altar craftsman. His elder brother, Masanori Akasaki, became a plasma physicist, a professor at Kyushu University, and president of Fukuoka Institute of Technology.

When he was a child, his father gave him many ore specimens, each a different luster and color. The boy was soon taken with the charm of ore. This early experience may have inspired him to enter the field of crystal growth research.

His birthplace, Chiran, is famous for an Army Special Attack Unit Base during World War II. He experienced student mobilization and many air raids during his middle school years. He said he even saw the face of a pilot firing a machine gun from the airplane. Those experiences led to his strong belief that war must not occur anymore.

After graduating from Kyoto University with a BS degree in 1952, he joined Kobe Kogyo Co., Ltd. to develop CdS-based fluorescent materials at the surface of a cathode-ray

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tube—his first encounter with "luminescence." His boss was Tetsuya Arizumi. Both men went to work in the Department of Electronic Engineering when it was established at Nagoya University in 1959.

At Nagoya University, Professor Akasaki concentrated on vapor-phase epitaxial growth and thermodynamic analysis of germanium (Ge). He found the "semiconductor" and its "crystal growth" attractive.

In 1964 he received his doctorate of engineering degree from Nagoya University—the title of his thesis was "Vapor phase epitaxial growth of Ge"—and moved to Matsushita Research Institute Tokyo, Inc. (formerly Tokyo Research Lab, Matsushita Electric Industrial Co., Ltd.). There he devoted himself to research on a series of III-V compound semiconductors including gallium arsenide (GaAs), gallium phosphide (GaP), and gallium nitride (GaN), and encountered light-emitting diodes (LEDs).

He initially concentrated on growing highly pure GaAs by vapor-phase epitaxy on a GaAs substrate grown by the horizontal Bridgman method for Gunn diode application. His group grew both GaAs substrates and high-purity epitaxial layers by themselves. As for the crystal growth of GaP, he experienced several hydrogen explosions. The GaP high-pressure furnace for red and green LEDs is displayed at the Akasaki Institute of Nagoya University.[1]

He started nitride research in 1967. In the early 1970s several research groups around the world were trying to fabricate blue LEDs with GaN; these included RCA Laboratories and Bell Labs in the United States, Lund University in Sweden, Philips in France, and the University of Tokyo.

[1] The institute was established in 2006 "with the purpose of introducing and disseminating the achievements of University Professor Isamu Akasaki and his worldleading research and development of high-brightness blue-light-emitting diodes (LEDs)…to the community at large" and "communicating the results of scholarship and research to the global community as an important base for cooperation between academia, government, and industry."

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Professor Akasaki started growing GaN crystals by the molecular beam epitaxy (MBE) method, overcoming objections from others around him about the choice of MBE, which grows crystals in a vacuum. In 1974, in a test project by the Ministry of International Trade and Industry, he observed only blue cathodoluminescence from the MBE-grown GaN. Later, he shifted his focus to vapor-phase growth using halogens and succeeded in prototyping a MIS-type blue LED. This blue LED research followed that developed by Jacques Pankove (NAE 1986) of RCA.

After this initial success, he wanted to continue this research. So when the manager of the company decided to stop the blue LED research, he left for Nagoya University in 1981 and started a new crystal growth method, metalorganic vapor-phase epitaxy. At the time, almost no other organizations were continuing GaN research. Most researchers considered that it was very difficult to grow single crystals and that p-type GaN growth was impossible, so they abandoned GaN and started ZnSe research. According to Professor Akasaki, his situation was like "going alone in the wilderness."

After a very fruitful career at Nagoya University, in 1992 he accepted a position as Special Distinguished Professor at Meijo University, where he remained actively engaged until his passing.

His achievements in the demonstration of p-type GaN and many other innovations led to extraordinary awards and honors: the Japanese Association for Crystal Growth Prize (1989), Heinrich Welker Gold Medal (1995), Medal with Purple Ribbon (1997); five honors in 1998—the Inoue Harushige Prize, C&C Prize, International Organization for Crystal Growth Laudise Prize, IEEE Jack A. Morton Award, and British Rank Prize; in 1999 both the ECS Gordon E. Moore Medal for Outstanding Achievement in Solid State Science and Technology and the Toray Science and Technology Prize; the Asahi Prize (2001); in 2002 the Takeda Award, Fujihara Award, and Order of Rising Sun; the President's Award from the Science Council of Japan (2003); designation as a Person of Cultural Merit (2004); in 2006 the TMS John Bardeen Award

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and Outstanding Achievement Award from the Japanese Association for Crystal Growth; the Kyoto Prize (2009); in 2011 the IEEE Edison Medal and Order of Culture and Person of Cultural Merit; the Nobel Prize in Physics (2014, together with the author and Shuji Nakamura [NAE 2003]); Charles Stark Draper Prize (2015, with M. George Craford [NAE 1994], Russell Dupuis [NAE 1989], Nick Holonyak Jr. [NAE 1973], and Nakamura); UNESCO Medal (2016); and Queen Elizabeth Prize for Engineering (2021).

He was also a member of numerous academies and societies: fellow of the Institute of Electrical Engineers of Japan, Institute of Electronics, Information and Communication Engineers, and Japan Association for Crystal Growth; foreign member of the US National Academy of Engineering; member of the Engineering Academy of Japan, American Physical Society, Materials Research Society; honorary member of the Japan Society for Applied Physics, Science Council of Japan, Chemical Society of Japan, Physical Society of Japan, and Japan Academy; and life member of the Electrochemical Society and IEEE.

He actively supported researchers and generously donated several monetary prizes to Nagoya University, Japan Society for Applied Physics, and Japan Association for Crystal Growth. The Akasaki Awards have encouraged many researchers.

Professor Akasaki always tried to convey his experience to the younger generation, including through the establishment of consortiums and international conferences. In 1981, for example, when he moved from Matsushita Giken Co., Ltd. to Nagoya University, he started the Semiconductor Electronics Research Society and was instrumental in revitalizing the electronics industry in the central area of Japan near Nagoya.

In 1995 the Topical Workshop on Nitride Semiconductors was held. This was during the nascent period of blue LEDs using GaN, and the laser diode was on the verge of oscillation, so there was a lot of attention from the media. Amid the hustle and bustle, Professor Akasaki very effectively led the organizing and international advisory committee members, who hailed from Japan, the United States, Europe, and Asia.

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Nitride semiconductors have since developed rapidly around the world, giving rise to the International Conference on Nitride Semiconductors, International Workshop on Nitride Semiconductors, and International Symposium on Growth of Nitrides. In addition, an international symposium was held at the Akasaki Research Center, established at Nagoya University from part of the patent fee income from 2002, to widely introduce research results to the world. Invited foreign researchers said that it was like receiving a medal to be invited by Professor Akasaki.

The "wilderness" in which Professor Isamu Akasaki pioneered is now a prosperous and fruitful field where many researchers all over the world gather and bring happiness to the people of the world. Through his work, the fusion of luminescence, semiconductor, and crystal growth has contributed to the potential for illuminating 1.5 billion people around the world who do not have infrastructure such as power plants. We thank this pioneer for his efforts and leadership, and pray for his soul.

He is survived by his wife Ryoko and their two daughters, Reiko Miwa (Yuichiro) and Junko Akasaki (Kazuaki Takahashi).

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