MORIIZUMI Toyosaka "Pioneering Research on Devices and Measurement Technologies of Bioelectronics"

1. Biography

MORIIZUMI Toyosaka was born on February 19th,1942. He graduated from Tokyo Institute of Technology (Tokyo Tech) in 1964 and was awarded Ph.D. Engineering from Tokyo Tech in 1969. He became a research associate, Tokyo Tech in 1969, an associate professor in 1973 and a professor at Tokyo Tech International Cooperation Center for Science and Technology in 1985, respectively. He was a visiting associate professor at Carnegie Mellon University from 1978 to 1979. In 1988, he became a professor in the Department of Electrical and Electronics Engineering at Tokyo Tech, an emeritus professor in 2005 and a director of Tokyo Tech Thailand office from 2006 to 2009. During that period, he was a director of International Cooperation Center for Science and Technology from 1994 to 1996, a director of quantum nanoelectronics from 1996 to 1997, a councilor from 1997 to 1999, a Tokyo Tech vice president from 2000 to 2001.

He was awarded IEEJ Technical Development award (2001), IEICE Fellow (2000) and IEEJ Outstanding Achievement Award (2007). He passed away on February 6th, 2010.

2. Research Summary

MORIIZUMI Toyosaka began to study bioelectronics in 1978 and then contributed to the development and the progress of that field. He combined chemical/biological fields with semiconductor microfabrication technology to create a new field, i.e., bioelectronics. Moreover, he contributed to the progress of sensing system adopting informatic technique, i.e., odor sensor using a neural network.

3. Research Achievement

3.1 Surface Acoustic Wave device

He studied an ultrasonic amplifier and a convolver utilizing an interaction between semiconductor and ultrasound (acoustoelectric effect) [1]. Then, he developed the ultrasonic imaging system using leaky SAW. Moreover, he found that the appropriate piezoelectric material, cutting orientation, propagation direction using numerical analysis and experimentally confirmed its usefulness, leading to an ultrasonic biosensor [2].

3.2 Biosensor

He immobilized the enzyme onto an ISFET (Ion Sensitive Field Effect Transistor) and made the biosensors to detect glucose and urea [3]. Then, he developed a miniaturized biosensor using thin film

electrode with immobilized enzyme. Moreover, he studied a chemical sensor using an ultra thin organic film, i.e., LB (Langmuir Blodgett) film and became a pioneer of molecular electronic devices [4]. Moreover, he developed the system to evaluate the deformability of red blood cell for the medical application [5]. He became a chief secretary of Molecular Electronics and Bioelectronics Division, The Japan Society of Applied Physics and the first chairperson of organic molecular electronics committee in IEICE, contributing to the progress of the organic electronics.

3.3 Odor sensor

He began to study an odor sensor in 1988. He proposed the method to use a neural network so that the pattern of the multiple gas sensors with different characteristics could be discriminated [6]. This method becomes nowadays a standard method of odor sensor. Moreover, he developed a robot equipped with gas sensors to localize the gas source. He succeeded in the experiment on finding the gas source, assuming the situation of the gas leakage in a clean room [7]. Furthermore, he proposed the environmental monitoring system using a gas sensor network [8]. He became a president of Sensor-Micromachine Society of IEEJ, contributing to the progress of the sensor field.

4. Remarks

He also contributed to the academic progress of Southeast Asian countries, promoting academic exchange and holding many seminars there.

5. References

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6. Representative books (all in Japanese)

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(Presented by Takamichi NAKAMOTO on July 1st, 2025)