

# Mitsumasa Koyanagi / Professor / Graduate School of Engineering

## Profile

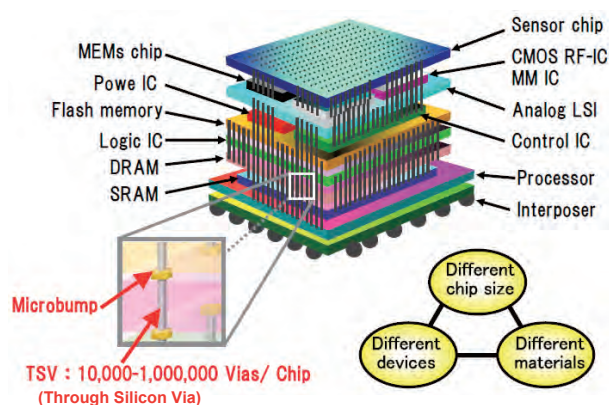


Mitsumasa Koyanagi received his BSc degree from the Department of Electrical Engineering, Muroran Institute of Technology Japan, in 1969 and his MSc and PhD degrees from the Department of Electronic Engineering, Tohoku University, in 1971 and 1974 respectively. He joined the Central Research Laboratory, Hitachi Co. Ltd. in 1974, where he engaged in the research of semiconductor memory (DRAM) and invented a Stacked Capacitor DRAM memory cell which has been widely used in computer systems. In 1985, he joined Xerox Palo Alto Research Center, California, where he was responsible for the research of submicron semiconductor devices and analog/digital LSI design. In 1988, he became a professor in the Research Center for Integrated Systems, Hiroshima University, Japan, where he engaged in the research of sub-0.1 $\mu$ m semiconductor devices, 3-D LSI, optical interconnection. Since 1994, he has been a professor in Intelligent System Design Lab., Department of Machine Intelligent and Systems Engineering, and currently Department of Bioengineering and Robotics, Graduate School of Engineering, Tohoku University. He was awarded the IEEE Jun-Ichi Nishizawa Medal in 2006, the IEEE Cledo Brunetti Award in 1996 and the Award of the Ministry of Education, Culture, Sports, Science and Technology (Japan) in 2002, in addition to the Ohkouchi Prize in 1992, the SSDM (Solid-State Devices and Materials) Award in 1994, and the Opto-Electronic Integration Technology Award (Izuo Hayashi Award) in 2004. He is an IEEE fellow and a Japanese Applied Physics Society fellow.

## Research Activities

I have engaged in research of high-density semiconductor memories and ultra small semiconductor devices. I invented a stacked capacitor DRAM which has been employed as a main memory in computer system. This memory has been also widely employed in information processing devices such as a cellular phones and game machines. It is the key in scaling down the size of semiconductor device in order to increase the packing density and the capacity of semiconductor memory. I then aimed to create ultra-small semiconductor devices with a dimension of several atoms to several tens of atoms. In addition, I have proposed a new three-dimensional integrated circuit (3-D LSI) by stacking LSI wafers. A 3-D LSI enables us to achieve a new computer system with low power and high performance, since 3-D structure is suitable for highly parallel information processing. Whereas a conventional LSI is approaching technological limitation, 3-D LSI has attracted considerable attention due to the possibility of replacing conventional LSIs. I have applied this 3-D LSI technology to the

biotechnology area and performed researches such as 3-D artificial retina chip implantation into eyes and 3-D brain-machine interface (BMI) module into brain cortex.



Structure of New Three-Dimensional LSI (Super-Chip)

## Message

I entered the Masters course of Tohoku University, since I desired to receive the guidance of Professor Jun-ichi Nishizawa, who achieved outstanding results in the research area of semiconductors. I learned in Nishizawa's laboratory how important originality is in research and how important it is to aim to be the best of the world. These lessons were the origin of my research activities. I proceeded to the doctoral course in Nishizawa's laboratory. On the doctoral course, I was trained to think thoroughly, to challenge and never to give up. Two or three years after completing the doctoral course, I invented a new semiconductor memory which has significantly accelerated the development of the world's semiconductor industry. I could not have invented such a device if I had not trained in Nishizawa's laboratory and had not proceeded to the doctoral course. Therefore, I recommend those younger students who are considering a job related to research and development in the future to enroll in the doctoral course.

I also recommend younger people to have experiences of study or research abroad. To experience globally advanced environments and different cultures when they are young will significantly impact on their future. I was relatively senior when I moved to the United States and so I often regretted that I did not do when I was much younger. I joined the Xerox Palo Alto Research Center in the United States, which is located in the center of Silicon Valley. Silicon Valley is the place where many talented people gather from all the countries of the world. Therefore, I often felt that the energy to challenge new things was spontaneously generated in my heart. I hope that younger people will have such international experiences and challenge for their own dreams world-wide.