Awards

4th JSAP Outstanding Achievement Awards

The "JSAP Outstanding Achievement Award" recognizes outstanding individual achievements in the field of applied physics. The JSAP Executive Board selects the recipients based on the recommendations of the Awards Committee appointed by the president of JSAP. Three recipients of the awards mentioned below had commemorative talks during the Spring Meeting of Japan Society of Applied Physics, March 2004.

Research Accomplishments

Recipient: ***Dr. Hiroyuki Matsunami***
Professor emeritus, Kyoto University Director, IAI Japan Science and Technology Agency, Research Results Application Plaza in Kyoto
Citation: For pioneering research of SiC semiconductor and its devices

SiC is a compound semiconductor with outstanding physical characteristics. Its bandgap is several times higher than that of Si. Its breakdown electric field is tenfold higher and saturation velocity is three times faster than that of Si. Therefore, it has the potential to improve the performance of the conventional Si and GaAs electronic devices dramatically, especially in the field of high power devices. However, difficulty of growing high quality crystals and fabricating devices has delayed the electronic device application for a long time. Dr. Matsunami recognized the importance of SiC in the late 60's and since then has been devoted to the research of this material and device. He always took the leading role in developing a practical semiconductor material. SiC shows multiple crystal types due to its complex crystal structure and it was almost impossible to grow a high-quality single crystal. He developed a method of controlling crystal growth in the atomic level using a proper off-angle substrate and succeeded in growing a high-quality epitaxial single crystal. By this method, research and development of SiC related materials have been expanded and accelerated on a global scale. This original research is widely recognized as a leading international research triggered by Japan.

He established the control techniques of p-type and n-type conductivity and also revealed the crystal growth mechanism academically using this growth method. He then clarified many specific physical properties of this high-quality SiC crystal. From 1993 to 1995, he made a trial fabrication of high-pressure, high-speed, low-loss SiC Schottky diodes and demonstrated the feasibility of devices which was far superior to the theoretical limitation for the first time in the world. Based on this achievement, high-pressure, high-speed SiC Schottky diodes and SiC MESFET have become a commercial reality. He also worked on research on SiO_2/SiC MOS interfaces. In 1999, he succeeded in improving the performance of MOSFET by 20 times using a new crystal orientation and set the grounds for the realization of high performance SiC power MOSFET.

It is highly expected that SiC will be applied to high-performance power conversion devices and high-frequency power devices. After all, not only does it lead to the effective use of energy and the reduction of environmental burden, but it will also lead to the paradigm shift of power electronics based on low-loss, high-power semiconductor devices. The outstanding leadership that he has exercised in an effort to put SiC into practical use is worthy of admiration and deserves the high honor of the outstanding achievement award.

Recipient: ***Dr. Takashi Mimura***
Research Fellow, Fujitsu Laboratories
Citation: For the invention and development of High Electron Mobility Transistor (HEMT)

In 1979, Dr. Mimura developed a revolutionary high-electron mobility electronic device with a channel layer separating from impurities, drawing on his findings that high-density two-dimensional electron gas was formed at a hetero-interface formed between two semiconductors with different band-gap. He applied for a patent for his invention and carried out development and trial manufacture and unveiled it as "High Electron Mobility Transistor (HEMT)" in JJAP. This paper was selected as Citation Classic of Institute for Scientific Information because of its remarkable achievement of materializing the first field-effect device using a hetero-interface.

He continuously played a leadership role in research and development toward the practical use of HEMT and made considerable contributions to the product development of a low noise amplifier in microwave and millimeter wave ranges. HEMT became a commercial reality in 1985 as a low noise receiver for radio telescope and it contributed to the progress of radio astronomy. HEMT changed its forms from AlGaAs/GaAs to InGaP/GaAs, InAlAs/InGaAs and and their pseudomorphic system. Because of its excellent high-speed and low noise characteristics, it has been widely applied for satellite broadcast receiver, cellular phone, car navigation receiver and millimeter automobile radar as a basic technology that is indispensable to IT society. Recently, further product development moves ahead to meet a variety of needs for AlGaN/GaN and strained Si/SiGe HEMTs and further market expansion is anticipated. Ultimately, HEMT was taken up as one of the nano-technologies in National Nanotechnology Initiative published by Clinton administration in January 2000, and took a share in the world attention for nano-technology. Invention of HEMT has also accelerated the development of thin layer growth technologies such as MBE and MOCVD that could bring about a change in the crystal composition at extreme precision and has made significant contribution to the later development of electronic devices and optical devices using compound semiconductors. In view of today's global understanding of mesoscopic physics triggered by the development of these device technologies, HEMT has scientifically tremendous spin-off effects. These achievements deserve the high honor of the outstanding achievement award.

Educational Accomplishments

Recipient: ***Dr. Tadao Tsuruta***
Corporate Advisor, Nikon Corporation
Citation: For educational contributions of his scientific work "PENCIL OF RAYS"

Dr. Tsuruta has made considerable contributions to the fostering and education of students and younger researchers in the field of optics through his longstanding academic and literary activities. Among others, "PENCIL OF RAYS - Applied optics for optical engineers" (series of 6 volumes, 3,000 pages) is a masterpiece of his wisdom accumulated over a period of times. The work gives profound insight into physics and practical technology in the business world. He explains how extensively today's applied physics is intertwined with classical optics fields with his unique writing style and witty description cultivated by his wide array of knowledge.

He delves deeply into the original papers written by the great physical scientists such as Newton and Rayleigh by casting a contemporary perspective. Not only does he give readers a joy of reliving the experiences of their findings, but he also casts a new light to classical optics and teaches us the importance of learning from the past. In the long history of optics field, there were certainly many great works including Principles of Optics (Born and Wolf) as a sort of bible. However, his "PENCIL OF RAYS" presents unique writing style and educational approach with no precedent in the past and stands out in terms of content and originality. Six volumes of "PENCIL OF RAYS" have won enthusiastic support from many readers including younger researchers and engineers, so the author's contribution to the education of applied physics education deserves to be highly praised.