

# THE *Current*

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## **UCSB Materials Professor Shuji Nakamura Wins Nobel Prize in Physics**

The 2014 Nobel Prize in Physics has been awarded to Shuji Nakamura, professor of materials and of electrical and computer engineering at the University of California, Santa Barbara, and two others.

The prize is for the invention of efficient blue light-emitting diodes, which has enabled bright and energy-saving white light sources, and is shared with Isamu Akasaki of Meijo University and Nagoya University, Japan; and Hiroshi Amano of Nagoya University.

According to the Royal Swedish Academy of Sciences, when Nakamura, Akasaki and Amano “produced bright blue light beams from their semiconductors in the early 1990s, they triggered a fundamental transformation of lighting technology. Red and green diodes had been around for a long time, but without blue light, white lamps could not be created. Despite considerable efforts, both in the scientific community and in industry, the blue LED had remained a challenge for three decades.”

The LED lamp “holds great promise for increasing the quality of life for over 1.5 billion people around the world who lack access to electricity grids,” the academy continued.

Nakamura, who is also co-director of the campus's Solid State Lighting & Energy Electronics Center, is the sixth faculty member at UCSB to have won a Nobel Prize since 1998. UCSB alumna Carol Greider received the 2009 Nobel Prize in Physiology or Medicine.

"I am very honored to receive the Nobel Prize from The Royal Swedish Academy of Science for my invention of the blue LED," said Nakamura. Speaking to a room full of reporters and students who had gathered in the campus's Engineering Sciences Building for a press conference on Oct. 7, Nakamura said it makes him happy to see his dream of LED lighting become a reality. "Nowadays we can buy energy-efficient LED light bulbs at the supermarket and help reduce energy use. I hope this helps global warming, too."

Praising Nakamura's great accomplishment, UCSB Chancellor Henry T. Yang offered his congratulations on behalf of the entire campus community. "We are overjoyed to congratulate our colleague Professor Shuji Nakamura on his Nobel Prize. This is a wonderful day of celebration for all of us at UC Santa Barbara, and for our extended community of scholars, alumni, colleagues, and friends around the world," said Yang.

"Dr. Nakamura has helped to pioneer a scientific revolution in solid-state lighting, with far-reaching impact on fields ranging from information and communication, to energy and the environment, to health care and life sciences," Yang continued. "By making it possible to bring affordable, energy-efficient LED lighting to developing countries, Professor Nakamura has also made a tremendous humanitarian contribution to our world."

UC President Janet Napolitano also noted Nakamura's achievement and the research that made it possible. "We honor and celebrate UC Santa Barbara's Shuji Nakamura, who has been recognized with a Nobel Prize in Physics for his transformational research that has revolutionized lighting technology," she said. "He and his two Japanese colleagues invented the technology that enabled bright and energy-saving white light sources, which promises to vastly improve the lives of people across the globe without access to electricity grids.

"This Nobel Prize, the 62nd awarded to a UC faculty member or researcher, underscores the paramount importance of research conducted at the University of California. Professor Nakamura's dedication to science, research and teaching are a

hallmark of or public universities,” Napolitano continued. “On behalf of the entire UC community, I join UC Santa Barbara Chancellor Henry Yang in extending heartfelt congratulations to Professor Nakamura and his colleagues.”

Said Rod Alferness, dean of UCSB’s College of Engineering: “This is an incredible honor for Professor Nakamura and the College of Engineering. Dr. Nakamura’s achievements in solid-state lighting continue to have far-reaching impact on lighting and computing technology. We all have his pioneering research to thank for the LED light bulb, monitors, mobile devices, and large flat screen displays that we enjoy today.”

Steven DenBaars, professor of materials and co-director of the Solid State Lighting & Energy Electronics Center, noted: Dr. Nakamura’s discovery in GaN materials for the high-brightness blue LEDs was the fundamental breakthrough leading to energy efficient LED lighting and displays. His work has resulted in new industries in clean technology, and in reducing energy consumption for illumination. Eventually, we expect the majority of all lighting to be done with LED’s.”

Nakamura credited his scientific success to those who have supported him over the course of his career. “I got my first break from Nobu Ogawa, chairman of Nichia, who supported my gamble to make a blue LED,” Nakamura recalled. “Also my young colleagues at Nichia helped a lot. I am also grateful for the support of UCSB Chancellor Henry Yang, and the Solid State Lighting and Energy Electronics Center, which has continued to support my research on LEDs and lasers, and my dream of LED lighting.”

Currently in Hawaii in his capacity as the chair of the Thirty Meter Telescope (TMT) International Observatory, Yang was unable to participate in the press conference. However, he made his thoughts and well wishes known by way of a special statement read by Executive Vice Chancellor David Marshall.

“What a thrill it was to receive the early-morning phone call about Professor Shuji Nakamura,” he said. “Ever since Shuji’s invention of the blue light-emitting diode and energy-efficient white LED, he and our colleagues have been pioneers not only of a new field of research, but of a scientific revolution. Truly we have just begun explore the full potential of solid-state lighting and energy technologies.”

In his message, Yang recalled a story told by another UCSB Nobel Laureate, Professor Herbert Kroemer, who won the prize in 2000. Kroemer described seeing a

bright blue LED for the first time in 1994 — and “suddenly,” he said, “the world had changed.” Kroemer heard Nakamura deliver a lecture in Berlin that same year. Nakamura showed images on an LED panel, and Kroemer turned to the colleague next to him and said, “What we are seeing here is the beginning of the end of the light bulb. We are not just talking about doing things better, but about doing things we never could before.”

Kroemer was right, Yang continued. The applications and impact of Nakamura’s inventions are far-reaching: from information and communication to energy and the environment, to health care and life sciences. “By making it possible to bring affordable, energy-efficient LED lighting to developing countries, Professor Nakamura has also made a tremendous humanitarian contribution to our world.”

Nakamura, who is also a member of the Lighting Solutions Group within UCSB’s Institute for Energy Efficiency, was born on May 22, 1954, in Ehime, Japan. He completed his bachelor’s, master’s, and doctoral degrees in electrical engineering from the University of Tokushima, Japan.

He joined the UCSB faculty in 2000 and was appointed to the Cree Chair in the Solid State Lighting and Display Center in 2001. Known for his technological achievements with semiconducting gallium nitrides, he is widely recognized as the world pioneer in light emitters based on the wide-bandgap semiconductor gallium nitride (GaN) and its alloys with aluminum and indium.

Before coming to UCSB, Nakamura had worked in research for Japan’s Nichia Chemical Industries Ltd, and spent a year at the University of Florida as a visiting research associate. In 1989, he started the research of blue light emitting diodes (LEDs) using group-III nitride materials. In 1993 and 1995, he developed the first group-III nitride-based blue/green LEDs. He also developed the first group-III nitride-based violet laser diodes (LDs) in 1995.

The development of nitride-based semiconductors by Nakamura represents one of the most important achievements in the materials science of semiconductors in the last 30 years. Specifically, the discovery of p-type doping in Gallium Nitride (GaN) and the development of blue, green, and white LEDs and blue LDs have enabled energy efficient lighting and displays. Nakamura discovered that p-type GaN films could be obtained by doping GaN with Mg, with successive post-thermal annealing in nitrogen ambient. At UCSB, Nakamura continues to develop GaN thin-film

technology.

In 2007, a team of UCSB researchers led by Nakamura reported a major breakthrough in laser diode development. The researchers from the Solid State Lighting and Energy Center achieved lasing operation in nonpolar GaN semiconductors, and demonstrated the world's first nonpolar blue-violet laser diodes.

Nakamura earned his undergraduate, master's, and doctoral degrees at Japan's University of Tokushima. He is the recipient of numerous prestigious awards including the LED Pioneer Award (2012); the Technology and the Engineering Emmy Award (2011); The Harvey Award (2009); the Prince of Asturias Award for Technical Scientific Research (2008); the Czochralski Award (2007); the Millennium Technology Prize (2006); the Benjamin Franklin Medal (2002); the Institute of Electrical and Electronics Engineers' Jack A. Morton Award, the British Rank Prize (1998); the Materials Research Society Medal (1997); and the Nishina Memorial Award (1996). He was elected to the U.S. National Academy of Engineering in 2003.

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The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.