LEDZED About LED technology

Introduction

In 1879 an American inventor named Thomas Alva Edison brought light bulbs in to the open market.

The light bulb technology is based on incandescent filaments. The filament breaks easily and is rather short-lived. Only 5% of the electricity they use is transformed in to light and the rest produces heat.

Because of the many disadvantages of light bulbs new illumination techniques have been developed. These include the compact fluorescent lamps. They are, however, a biohazard because of the mercury they contain.

The latest innovation is LED lights which save the most energy of all illumination systems and does not contain hazardous waste to the environment.

This has been made possible by the white LED (Light Emitting Diode) developed by the Millennium Award winner Shuji Nakamura. LEDs can be used both for dim and bright lighting.

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Millennium Technology Prize winner Professor Shuji Nakamura and his work

Professor Shuji Nakamura is one of the most significant inventors of our time.

In 1993, he stunned the optoelectronic community with the announcement of very-bright blue GaN-based light emitting diodes (LEDs). In rapid succession, he then announced a green GaN-based LED, a blue laser diode, and a white LED.

All these developments were things that other researchers in the semiconductor field had spent decades trying to do.

Professor Nakamura's story is unique. Born in 1954 in Japan on the island called Shikoku, he received his master's degree in 1979 at the University of Tokushima. He started his scientific and technological career outside mainstream Japanese technology, working as an engineer at Nichia Chemical, a small phosphor company in the countryside.

At Nichia Chemical's laboratory, with only a limited budget and modest support from company management, Nakamura developed a highly-original two-flow growth system which led to the successful epitaxial growth of gallium nitride (GaN) in 1989.

Three years later, he managed to produce p-type GaN, a fundamental breakthrough in III-V nitride research. Since the beginning of research into GaN almost three decades earlier, no-one had been able to create this particular compound.

In 1993, to universal surprise, Nakamura demonstrated bright-blue LEDs.

Two years later he announced a green GaNbased LED, a blue laser diode, and a white LED.

Professor Nakamura patented his innovations.

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White LED – revolutionizing illumination

Professor Nakamura's next step was to add a novel phosphor to his blue chip to obtain white light.

Domestic 60-watt light bulbs emit a lot of electromagnetic energy in the infrared section of the spectrum. While this radiation cannot be seen, it can be felt as heat.

The essence of this innovation is to eventually replace the world's inefficient incandescent light bulbs with white LEDs to reduce the amount of energy required to produce light.

An additional benefit will then be accomplished through a significant reduction in air-conditioning costs.

Not only do white LEDs produce light energy more efficiently, they have a working life of orders of magnitude longer than conventional light bulbs.

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Professor Nakamura's work continues

In 1994, Nakamura received his doctorate in engineering at the University of Tokushima.

Five years later he left Japan and joined the faculty of the University of California, Santa Barbara (UCSB). At UCSB he has built up a significant research programme in new areas of nitride research.

Professor Nakamura's current research interests are the growing of optoelectronic materials and the fabrication of novel semiconductor devices. In more specific terms, he is working on new devices including full-colour LEDs, an efficient white-LED light bulb, laser diodes and high-power, microwave communication devices.

Nakamura's inventions in both GaN materials and associated devices are having an extensive impact in many areas that improve human quality of life and promote sustainable development.

Applications that have already been developed by using Nakamura's technology can reduce energy consumption, bring reading lights to the outermost areas of developing countries, sterilise water in a more efficient and cheaper way, and store data in much smaller spaces.

New applications for the technology and ways of using it to improve human quality of life are being developed all the time.