Solid-state Lighting and Sustainable Development

Details

Speaker:
Prof. CHUA Soo Jin Department of Electrical and Computer Engineering National University, Singapore Date: Thursday, 15 April 2010

Time:
9:30 am

Venue:
Lecture Theatre C, Chow Yei Ching Building

Abstract:

Lighting has evolved over the centuries and can be broadly categorized by the use of fire, incandescence from filaments and fluorescence and electrical discharge in gases. The use of each new material has led to the improvement in luminous efficacy by an order of magnitude. The incandescence light bulb, invented by Edison in 1879, will be phased out over the next few years as governments sought to ban its manufacture and use because of its low efficiency (< 5%). They are being replaced by the compact fluorescence lamps and the high brightness LEDs. The latter is referred to as Solid-state Lighting as it is made from semiconductors. The fluorescent lamp's luminous efficacy has remained constant at about 80 lumens/W, or about 25%, over the past fifty years and is now overtaken by the LEDs, made from the group-III Nitride semiconductors with luminous efficacy of about 100 lumens/W for commercial samples while in the labs, it has achieved about 180 lumens/W (Nichia). The 100% efficiency corresponds to a luminous efficacy of about 400 lumens/W. There are thus rooms for improvement. To provide impetus for development, the US Department of Energy has instituted the Lighting-Prize, initiating a race to develop the first practical 60-watt LED equivalent to a standard light bulb. For sustainable development not only must the LEDs use a fraction of the electricity of a regular light bulb to create the same amount of light, the whole manufacturing and distribution process should also use less energy as well. A recent study showed that over the entire life of the bulb — from manufacturing to disposal — the energy used for incandescent bulbs is almost five times that used for compact fluorescents and LED lamps. With lighting taking up as much as 25% of our energy needs, the savings from a more efficient light source is not just in terms of cost but contributing to towards reduction in global warming. The talk will focus on the development of high brightness and white light LEDs for illumination applications. Areas for technological improvements will be discussed. One direction the Institute of Materials Research and Engineering in collaboration with the National University of Singapore has under taken is the direct generation of white light without the use of phosphors. As cost is still an issue for widespread adoption of LED luminaires, new development that can replace the existing materials is being explored.

Biography of the speaker:

Dr Soo-Jin Chua is Professor of Optoelectronics at the Department of Electrical and Computer Engineering, National University of Singapore. Concurrently, he holds the positions of Deputy Executive Director, Institute of Materials Research and Engineering (IMRE) and Deputy Director, Singapore-MIT Alliance. His research interest is in III-Nitrides grown by MOCVD, ZnO by hydrothermal synthesis, and fabrication of optoelectronic devices such as semiconductor lasers and optical waveguide components and applications of nanostructures in Optoelectronics. He has published more than 400 journal papers and authored or co-authored 30 patents. He pioneered the use of InAs quantum dots for photodetection in the 3 to 5 μm wavelength range and the use of InGaN quantum dots for the generation of white light.

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