ECE Distinguished Seminar Series

IEEE EDS/LEOS Distinguished Lecturer

Innovations in Light-Emitting Diodes
for Solid-State and Smart Lighting Applications

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1:30 PM, Thursday, April 27, 2006
New! Smith Seminar Room, Room 1080 PRB
Simulcast on the web via: http://sg60.oar.net/EDSLEOS/

The use of highly efficient semiconductor light-emitting diodes (LEDs) suitable for illumination applications will enable huge energy savings, reduction in green-house gas generation, and reduction of environmental pollution. Luminous source efficiencies exceeding 300 lm/W and color-rendering indices (CRI) greater 90 are feasible with solid-state sources. This talk discusses critical issues in solid-state lighting, including practical limits to efficacy and efficiency, and scalability of chip size and current density. Possible solutions to current device-performance limitations are presented: A new type of triple-layer omni-directional reflector (ODR) with a mirror loss that is two orders of magnitude lower than the mirror losses of either metal reflectors or distributed Bragg reflectors (DBR). One layer of the reflector consists of a new class of dielectric materials, low-refractive-index materials, with a very low refractive index, close to that of air. The low-index material is based on highly porous SiO_2 and is deposited by oblique-angle evaporation. We will also present results on white LEDs with remote phosphor distributions. Such phosphor distributions offer higher efficiency than conventional proximate phosphor distributions. Solid-state sources based on LEDs have advantages not offered by conventional light sources, namely tunability and adaptability. In contrast to conventional incandescent and fluorescent sources, future smart light sources based on LEDs offer control of their spectral composition, spatio-chromatic emission pattern, temporal modulation, polarization, and color temperature. This will allow for fundamental innovations in bio-imaging, communications, circadian lighting, and the optimization of light sources for specific applications. Several specific application areas will be discussed.

E. Fred Schubert (Ph. D. 1986) is the Wellfleet Senior Constellation Professor of the Future Chip Constellation at Rensselaer Polytechnic Institute. He has made pioneering contributions to the field of compound semiconductors in particular to alloy broadening, delta-doping, resonant cavity light-emitting diodes, enhanced spontaneous emission in Er-doped Si/SiO_2 microcavities, elimination of heterojunction band discontinuities, p-type superlattice doping in AlGaN, polarization-enhanced ohmic contacts, and omni-directional reflectors for LEDs. He is co-inventor of 28 US patents and co-authored more than 200 publications. He authored the books Doping in III–V Semiconductors (1992), Delta Doping of Semiconductors (1996), and Light-Emitting Diodes (2003). He is a Fellow of the APS, IEEE, OSA, and SPIE and has received several awards.

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