Solid State Lighting

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The development of high-brightness light emitting diodes (LEDs) based on III-nitrides and AlInGaP has led to the possibility of revolutionary new approaches for lighting and general illumination called solid state lighting (SSL). Efficient UV/blue solid state sources fabricated from III-nitrides can be coupled to phosphors for visible color and white light generation. Red, green, and blue LEDs can be combined to make high brightness and dynamically adjustable white sources. However, while an LED can now exceed the luminous efficiencies of incandescent light bulbs ($>$30 lm/W), they must improve both total light output and cost per lumen output to be competitive with existing lighting technologies. LEDs typically operate at powers from 0.1 to 5 W compared to many tens of watts for an incandescent source. A current LED light source costs $\sim$\$0.10 per lumen compared to $<$\$0.001 per lumen for traditional light bulbs. LED structures designed to maximize the light extraction efficiency and operate at higher powers for high lumen output are now being produced. However, many material and device challenges still remain such as improving high-power efficiencies and high-temperature performance. To date, no major penetration into general illumination has been achieved for SSL. The following papers show an in-depth study of the current properties of LEDs for SSL and their future use in general illumination.

LEDs are an ideal source for next-generation general lighting due to LEDs' ability to show new functionality compared to traditional lighting sources. In contrast to traditional lighting with a fixed color temperature, Fryc et al. are making a spectrally tunable light source. The source will have the ability to produce any spectral power distribution in the visible range by using feedback control of individual LEDs. In You's work a different approach is proposed; the addition of correction filters to mimic a wide range of white light sources using LEDs. Uchida et al. take another approach using near-UV LED and multiphosphor materials to make an orange, yellow, green, and blue (OYGB) LED, which demonstrates irradiance greater than that of present white LEDs. Ohno shows in his paper that both good color rendering and high luminous efficacy are important for white light LEDs. In this work different models of 3-chip, 4-chip, and phosphor-type LEDs were demonstrated. Brown et al. complete a comparison of halogen-based MR16s, popular as accent lighting in rooms, with commercially available LED-based MR16s. This work clearly shows that solid state light sources based on LEDs still have to show much improvement to be competitive with traditional light sources.

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Ian Ferguson is a professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology (Georgia Tech). Since arriving at Georgia Tech he has been made the director for the Focused Research Center on Next Generation Lighting and a professor in the School of Materials Science and Engineering. Dr. Ferguson is a native of Scotland and attended Heriot Watt University in Edinburgh, Scotland, where he received a BS with honors in 1984. He continued his studies at the University of St. Andrews in Scotland, obtaining a MS in 1986 and his PhD in 1989 in optoelectronics and compound semiconductor materials and devices. Dr. Ferguson joined Georgia Tech from EMCORE Corporation where he served as director of research. Prior to this, he worked with interdisciplinary research groups at Northwestern University in Evanston, Illinois, and at the Imperial College in London, England. Dr. Ferguson has a particular interest in research that involves an interdisciplinary approach that is often conducted in collaboration with industry partners. Dr. Ferguson's research focuses on the area of wide bandgap materials and devices (emitters, detectors, and electronics) using GaN and ZnO-based materials and developing these materials for illumination and spintronic applications. He also has been actively involved in the entrepre-

neurial process of establishing new companies. Dr. Ferguson founded and chairs the International Conference of Solid State Lighting that is hosted by SPIE. He has over 140 referenced publications, has authored three book chapters, currently is editing two books, and holds four patents.

John C. Carrano is currently the executive director of research and development for Luminex Corporation, a publicly traded biotech company based in Austin, Texas. In this capacity, Dr. Carrano is responsible for a staff of approximately 50 scientists and engineers developing next generation optically-based medical instrumentation used in the drug discovery and clinic diagnostics industries. Dr. Carrano received his BS from the United States Military Academy, West Point, in 1981, and was commissioned a regular officer in the United States Army. He then served in a variety of command and staff positions in the U.S. and Europe. Most recently, Dr. Carrano was assigned to DARPA from January 2001 to May 2005 as a program manager in the Microsystems Technology Office. Dr. Carrano was responsible for the management of the SUVOS, AFPA, STAB, and L-PAS programs and he had oversight of several other photonics efforts. His other recent positions include assistant professor of electrical engineering, Department of Electrical Engineering and Computer Science, United States Military Academy, and research scientist, U.S. Army Research Laboratory, Adelphi, Maryland Dr. Carrano retired from the military as a lieutenant colonel in June 2005, after over 24 years of active duty service to the nation. He received his MS and PhD in electrical engineering from the University of Texas at Austin. Dr. Carrano is also a graduate of the U.S. Army Command and General Staff College. His interests include optoelectronic devices and optical systems for advanced sensing and detection applications. He has co-authored over 50 scholarly publications and numerous conference presentations, including one best paper award, and he has authored one book chapter. Dr. Carrano is a member of Phi Kappa Phi, Eta Kappa Nu, OSA, SPIE, and IEEE.