Solid state lighting

Michael S. Shur
Rensselaer Polytechnic Institute, USA

Breakthroughs in artificial light sources – a piece of burning wood invented more than 500,000 years ago, gas lighting (1772), electric lighting (1876), and fluorescent lamps (1938) – have led to the development of modern lighting sources. These include tungsten incandescent and compact fluorescent lamps for residential use, fluorescent lamps for work environments, and ugly sodium lamps for street lighting. Today, 17% of energy use is in lighting, and, perhaps, half of this energy can be saved by switching to efficient and cold solid-state lighting sources. Projected cumulative financial savings from solid-state lighting might reach $115 billion by year 2020.

Solid-state lighting will use visible and UV LEDs that are projected to reach lifetimes exceeding 100,000 hours. The efficiency of white LEDs (now approximately up to 20 lm/W, already twice of that for incandescent lamps) is expected to reach 50 lm/W by year 2010. From traffic lights to road signs, from automobile taillights to outdoor displays, from landscape to accent lights, solid-state light sources have already arrived as harbingers of the next lighting revolution. This revolution will rely on AlN/GaN/InN wide band gap semiconductors grown on sapphire, silicon carbide, silicon, and homoepitaxial substrates. I will review the principle of operation, designs, and performance of super bright blue and UV AlGaInN-based LEDs for applications in solid-state lighting.