LED Luminance is Dramatically Improved

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LED omni-directional reflector developed by Rensselaer researchers could brighten LEDs enough to replace the conventional light bulb

A research team at Rensselaer Polytechnic Institute has created a new type of reflector that has dramatically improved LED (light-emitting diodes) luminance. The National Science Foundation (NSF) recently awarded the research team a three-year, $210,000 grant to move the patented omni-directional reflector to market.

“We have developed an omni-directional reflector (ODR) for LEDs that will accelerate the replacement of conventional lighting used for a multitude of applications, such as lighting in homes, businesses, museums, airports, and on streets,” said Fred Schubert, Wellfleet Senior Constellation Professor of the Future Chips Constellation at Rensselaer who is heading the research effort. “The advance has implications ranging from major energy savings to contributing to a better environment and improving health.” New LED Technology LEDs are made from semiconductor “chips,” the size of sand grains, covered with arrays of pencil-eraser size plastic bulbs. Increasingly being used in traffic signals, automotive lighting, and exit signs, LEDs have the potential to use far less electricity and last much longer than conventional fluorescent and incandescent bulbs. But current LEDs are not bright enough to replace most everyday uses of the standard light bulb. “Only when the light generated is efficiently reflected inside the semiconductor can the brightness exceed that of standard lighting sources,” Schubert says. “With the ODR, which reflects light at nearly 100 percent — up to twice as much as previous reflectors — we now

have an LED that could revolutionize today's standard lighting." The ODR is a thin triple-layer coating that consists of a semiconductor, a dielectric material, and a silver layer. Reports of the new reflector were published in the May 31, 2004, issue of the journal of Applied Physics Letters and last October in the IEEE (Institute of Electrical and Electronics Engineers) journal of Electron Devices Letters. In addition to NSF funding, the researchers also have received $250,000 in the last two years from the Defense Advanced Research Projects Agency to develop the new reflector. Next-Generation LEDs: Cutting Energy Costs and Potential Medical Applications

Next-generation LEDs are expected to become the widespread "green technology" of choice for lighting, Schubert says. "With near ideal LEDs, our nation could cut electricity consumption for lighting in half," Schubert says. "Lighting is the most common use of electrical energy, taking up about 25 percent of electrical energy consumption in the United States."

Schubert also notes that LEDs are mercury-free, unlike even the newest energy-saving fluorescent bulbs. Mercury exposure can cause significant health problems in children and adults, according to National Institutes of Health.

In addition, an LED that emits higher-quality light has potential medical applications, such as alleviating sleep disorders, Schubert says. The circadian cycle, the 24-hour sleep-wake cycle in healthy humans, is controlled by the spectrum and intensity of light sources. Using the right light for the right time of day can enhance or hinder sleep.

For example, "tunable" light sources, such as LEDs, which emit longer wavelength light (red) that mimics the setting Sun could help those with insomnia sleep better. Individuals are not affected visually by the difference in "colored" light, but the body's internal clock can sense the difference, Schubert says. Conventional illumination sources cannot provide the same benefit because of the lack of "tunability," meaning their optical spectrum cannot be adjusted to emphasize various wavelengths.

Schubert, who won the 2000 Discover Magazine Award for his photon-recycling semiconductor LED invention, has helped to transform traffic signals and airport runway lighting through his numerous LED-based inventions. He holds appointments in the Department of Electrical, Computer, and Systems Engineering and in the Department of Physics, Applied Physics, and Astronomy at Rensselaer. The recently-completed Future Chips Constellation, in which he is a senior professor, focuses on innovations in materials and devices, in solid state and smart lighting, and extends to applications such as sensing, communications, and biotechnology.

Source: Rensselaer Polytechnic Institute