Nano scientists to develop next-generation LEDs

Nanotechnology may unlock the secret for creating highly efficient next-generation LED lighting systems, and exploring its potential is the aim of several projects centered at Oak Ridge National Laboratory.

Seen everywhere today from traffic signals, taillights and cell phone displays to stadium JumboTrons, light emitting diodes fluoresce as electrical current passes through them. The most developed LED technology is based on crystals, typically made from indium gallium nitride. However, researchers at ORNL's Center for Nanophase Materials Sciences and the University of Tennessee are working to develop technology that will improve a new generation of LED devices composed of thin films of polymers or organic molecules.

These organic LEDs are designed to be formed into thin, flexible sheets that hold promise for a new generation of lighting fixtures and flexible electronics displays. Currently applications of organic LEDs, or OLEDs, are limited to small-screen devices such as cell phones, personal digital assistants and digital cameras; however it is hoped that someday large displays and lighting fixtures can be produced using low-cost manufacturing processes.

At ORNL, researchers are developing electrodes composed of carbon nanotubes and magnetic nanowires to enhance the light emission from polymer-based OLEDs. In early tests, carbon nanotubes improved the electroluminescence efficiency of polymer OLEDs by a factor of four and reduced the energy required to operate them. Magnetic nanowires and dots have been shown to help control the spin of electrons injected into the OLEDs to further improve the efficiency and reliability of the devices. A third aspect of the research focuses on creation and chemical processing of the nanotubes themselves. Researchers at ORNL use a technique called laser vaporization produces purer nanotubes with fewer defects than other fabrication techniques.

With assistance of a $600,000 grant from the Department of Energy's Office of Energy Efficiency and Renewable Energy, the ORNL/UT team hopes to merge the science and new materials research into a new technology for practical OLED devices that consumes less than half the power of today's technology and opens the door for their practical use in household lighting.

"The real, long-term solution to making a more efficient device may be found in nanoscience," said David Geohegan, an ORNL researcher who is leading the OLED effort. "Over the next year we hope to learn why nanomaterials enhance these devices. I think someday we will see OLEDs everywhere, from more durable touch-screen displays to electronic newspapers that we can roll up and carry easily to even larger wall displays for home entertainment or lighting."

Source: Oak Ridge National Laboratory