Imagine illuminating your future home or business with flat, inexpensive panels that are environmentally friendly, easy on your eyes, and energy efficient because they create minimal heat. Now imagine how those panels could be used if they were as flexible as paper or cloth; the technology could be bent into shapes, fit the interior or exterior curves of vehicles, even be incorporated into clothing.

"Flexible organic light-emitting diodes for solid-state lighting" reports on advances in three key areas—flexible electrodes, flexible encapsulation methods, and flexible substrates—that make commercial use of such technology more feasible but still not within reach.

Organic light-emitting diodes (OLEDs) show promise as a future light source because of their thinness, light weight, energy efficiency, and use of environmentally benign materials. Companies such as Philips and LG Chemical have begun producing flat OLED panels that produce uniform, UV-free light but very little heat, with no need for lamp shades or diffusers.

OLEDs produce light by sending electricity through one or more thin layers of an organic semiconductor. The semiconductor is sandwiched between a positively charged electrode and a negatively charged one. These layers are deposited on a supporting surface called a substrate, and protected from exposure to the air by a thin layer of encapsulants (traditionally glass).

The authors of the report, a team of researchers at Pohang University of Science and Technology, South Korea, tested a variety of transparent electrodes that might work as flexible alternatives to currently available devices based on indium tin oxide (ITO), which is brittle and increasingly expensive.

They were able to demonstrate good electrical, optical, and mechanical performances of flexible electrodes fabricated using graphene, conducting polymers, Ag nanowires (AgNWs), and dielectric/metal/dielectric (DMD) multilayer structures. However, the researchers concluded that problems with these devices' durability (graphene), electrical conductivity (conducting polymers), surface roughness (AgNWs), and cost of fabrication (DMD multilayer structures) will need to be solved before they can be used in the production of solid-state lighting.

Similarly, flexible encapsulation methods have achieved a sufficiently low water vapor transmission rate (WVTR) and high bending stabilities, but present issues such as high cost, low throughput, long processing time, and relatively lower durability than conventional glass encapsulation. A new flexible lamination encapsulation method (called "Flex Lami-capsulation"), using a metal foil/elastic polymer bilayer, may offer properties comparable to glass encapsulation, high levels of flexibility, and reduced processing costs.

Flexible substrates have been made using either plastics or metal foil. Plastics have high WVTR and are therefore, not suitable; reducing the WVTR requires an additional organic/inorganic barrier coating layer. Metal foil substrates have sufficiently low WVTR but require surface treatment to reduce surface roughness.

The report suggests that next steps toward making flexible solid-state lighting commercially feasible include (1) the development of a flexible electrode that has high electrical conductivity, high bending stability, few defects, smooth surface morphology, and high work function; (2) a reduction in the WVTR of flexible encapsulants and substrates; and (3) an increase in the bending stability of flexible components.

Please note: Above is the content I submitted to Amy Nelson, Public Relations Manager for SPIE, based on the full article in the peer-reviewed *Journal of Photonics for Energy*. To see the final press release distributed by SPIE, visit the organization's website at http://spie.org/about-spie/press-room/press-releases/jpe-flexible-oleds-9-3-2015?SSO=1.