Researchers almost double light efficiency in LC projectors

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Researchers from North Carolina State University and ImagineOptix Corporation have developed new technology to convert unpolarized light into polarized light, which makes projectors that use liquid crystal (LC) technology almost twice as energy efficient. The new technology has resulted in smaller, lower cost and more efficient projectors, meaning longer battery life and significantly lower levels of heat.

All LC projectors – used from classrooms to conference rooms – utilize polarized light. But efficient light sources – such as light-emitting diodes, or LEDs – produce unpolarized light. As a result, the light generated by LEDs has to be converted into polarized light before it can be used.

The most common method of polarizing light involves passing the unpolarized light through a polarizing filter. But this process wastes more than 50 percent of the originally generated light, with the bulk of the "lost" light being turned into heat – which is a major reason that projectors get hot and have noisy cooling fans.

But the new technology developed at NC State allows approximately 90 percent of the unpolarized light to be polarized and, therefore, used by the projector.

The ImagineOptix-sponsored research team was also able to use the technology to create a small "picoprojector," which could be embedded in a smartphone, tablet or other device.

"This technology, which we call a polarization grating-polarization conversion system (PGPCS), will significantly improve the energy efficiency of LC projectors," says Dr. Michael Escuti, co-author of a paper describing the research and an associate professor of electrical and computer engineering at NC State. "The commercial implications are broad reaching. Projectors that rely on batteries will be able to run for almost twice as long. And LC projectors of all kinds can be made twice as bright but use the same amount of power that they do now. However, we can't promise that this will make classes and meetings twice as exciting."

Because only approximately 10 percent of the unpolarized light is converted into heat – as opposed to the more than 50 percent light loss that stems from using conventional polarization filters – the new technology will also reduce the need for loud cooling fans and enable more compact designs.

The technology is a small single-unit assembly composed of four immobile parts. A beam of unpolarized light first passes through an array of lenses, which focus the light into a grid of spots. The light then passes through a polarization grating, which consists of a thin layer of liquid crystal material on a glass plate. The polarization grating separates the spots of light into pairs, which have opposite polarizations. The light then passes through a louvered wave plate, which is a collection of clear, patterned plates that gives the beams of light the same polarization. Finally, a second array of lenses focuses the spots of light back into a single, uniform beam of light.

The paper, "Efficient and monolithic polarization conversion system based on a polarization grating," was published July 10 in Applied Optics. The paper was co-authored by Drs. Jihwan Kim and Ravi Komanduri, postdoctoral researchers at NC State; Kristopher Lawler, a research associate at NC State; Jason Kekas, of ImagineOptix Corp.; and Escuti. The research was funded by ImagineOptix, a start-up company co-founded by Escuti and Kekas.

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