Crystal coat warms up LED light

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Topping LEDs with a coating of carefully tuned nanocrystals makes their light warmer and less clinical, a new study shows. The researchers argue this is a must for energy-efficient LED lights to make headway in the commercial market.

Illuminating buildings accounts for about a quarter of the electricity used in the US, according to the Department of Energy. Because most of that electricity comes from coal-fired power plants, lights account for a significant amount of greenhouse gas emissions.

LEDs have the potential to be far more efficient than other lights, but face two major hurdles. Firstly, they trail behind fluorescent lights for efficiency and, secondly, the colour of typical commercial LEDs isn't pure white.

Most emit a "cool" light with a bluish tinge, sometimes called "lunar white", that most people find unattractive in the home. Now researchers have used nanocrystals to create LEDs that give off a warm white light.

Fine-tuned light

Their LEDs have a high "colour rendering index" of more than 80 out of 100, meaning objects will tend to appear their usual colour under the light. That is similar to the best fluorescent lights, but behind incandescent bulbs which define the index with a benchmark of 100.

To accomplish this, Hilmi Volkan Demir and colleagues at Bilkent University in Ankara, Turkey, coated blue LEDs with a layer of nanocrystals. These crystals are made from a core of cadmium selenide with a surrounding layer of zinc sulphide.

The crystals absorb some of the LED's blue output and emit their own red and green light. That combines with the remaining blue light to produce a soft white glow.

Existing commercial white LEDs are also based on blue LEDs. But they use a phosphor coating that converts some blue light into a broad spectrum of yellow light. When mixed with remaining blue light the result is a harsh blue-hued white.

Nanocrystals emit light in a much tighter range of wavelengths than phosphor, making it possible to fine-tune the colour produced, Demir says. "Using combinations of nanocrystals, one can generate any emission spectrum as desired," he told **New Scientist**.

Visible gains

The researchers used two different sizes of nanocrystals, which emit particular wavelengths of either green light or red light. The right mix of the two combines with blue light from the base LED to make a warmer white with twice as much red as blue or green.

The final LEDs were also better than commercially available LEDs at creating visible light, giving off more than 300 lumens of visible light for every watt of all light emitted. This figure, known as the "luminous efficacy", is high compared to typical white LEDs.

Carefully choosing the nanocrystals used tunes the light spectrum emitted towards frequencies that the human eye is most sensitive to. Typical white LEDs are less well matched to human eyes and provide only about 30 to 60 lumens of visible light per watt of light emitted.

"The reported values are remarkable," says In-Hwan Lee of Chonbuk National University in Jeonju, South Korea. But problems still remain, he adds. "Making the core-shell nanocrystals is quite difficult."

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