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Next generation LEDs may soon be here

Cost, technical performance and environmental impact – these are the three most important aspects for a new type of LED technology to have a broad commercial impact on society. This has been demonstrated by researchers at Linköping University in a study published in Nature Sustainability.

“Perovskite LEDs are cheaper and easier to manufacture than traditional LEDs, and they can also produce vibrant and intense colours if used in screens. I’d say that this is the next generation of LED technology,” says Feng Gao, professor of optoelectronics at Linköping University.

However, for a technological shift to take place, where today’s LEDs are replaced with those based on the material perovskite, more than just technical performance is required. That is why Feng Gao’s research group has collaborated with Professor Olof Hjelm and John Laurence Esguerra, assistant professor at LiU. They specialise in how innovations contributing to environmental sustainability can be introduced to the market.

Together, they have investigated the environmental impact and cost of 18 different perovskite LEDs, knowledge that is currently incomplete. The study was conducted using so-called life cycle assessment and techno-economic assessment.

Such analyses require a clear system definition – that is, what is included and not in terms of cost and environmental impact. Within this framework, what happens from the product being created until it can no longer be used is investigated. The life cycle of the product, from cradle to grave, can be divided into five different phases: raw material production, manufacturing, distribution, use and decommissioning.

“We’d like to avoid the grave. And things get more complicated when you take recycling into account. But here we show that it’s most important to think about the reuse of organic solvents and how raw materials are produced, especially if they are rare materials,” says Olof Hjelm.

One example where the life cycle analysis provides guidance concerns the small amount of toxic lead found in perovskite LEDs. This is currently necessary for the perovskites to be effective. But, according to Olof Hjelm, focusing only on lead is a mistake. There are also many other materials in LEDs, such as gold.

“Gold production is extremely toxic. There are byproducts such as mercury and cyanide. It’s also very energy-consuming,” he says.

The greatest environmental gain would instead be achieved by replacing gold with copper, aluminium or nickel, while maintaining the small amount of lead needed for the LED to function optimally.

The researchers have concluded that perovskite LEDs have great potential for commercialisation in the long term. Maybe they can even replace today’s LEDs, thanks to lower costs and less environmental impact. The big issue is

longevity. However, the development of perovskite LEDs is accelerating and their life expectancy is increasing. The researchers believe that it needs to reach about 10,000 hours for a positive environmental impact, something they think is achievable. Today, the best perovskite LEDs last for hundreds of hours.

Muyi Zhang, PhD student at the Department of Physics, Chemistry and Biology at LiU, says that much of the research focus so far is on increasing the technical performance of LED, something he believes will change.

“We want what we develop to be used in the real world. But then, we as researchers need to broaden our perspective. If a product has high technical performance but is expensive and isn’t environmentally sustainable, it may not be highly competitive in the market. That mindset will increasingly come to guide our research.”

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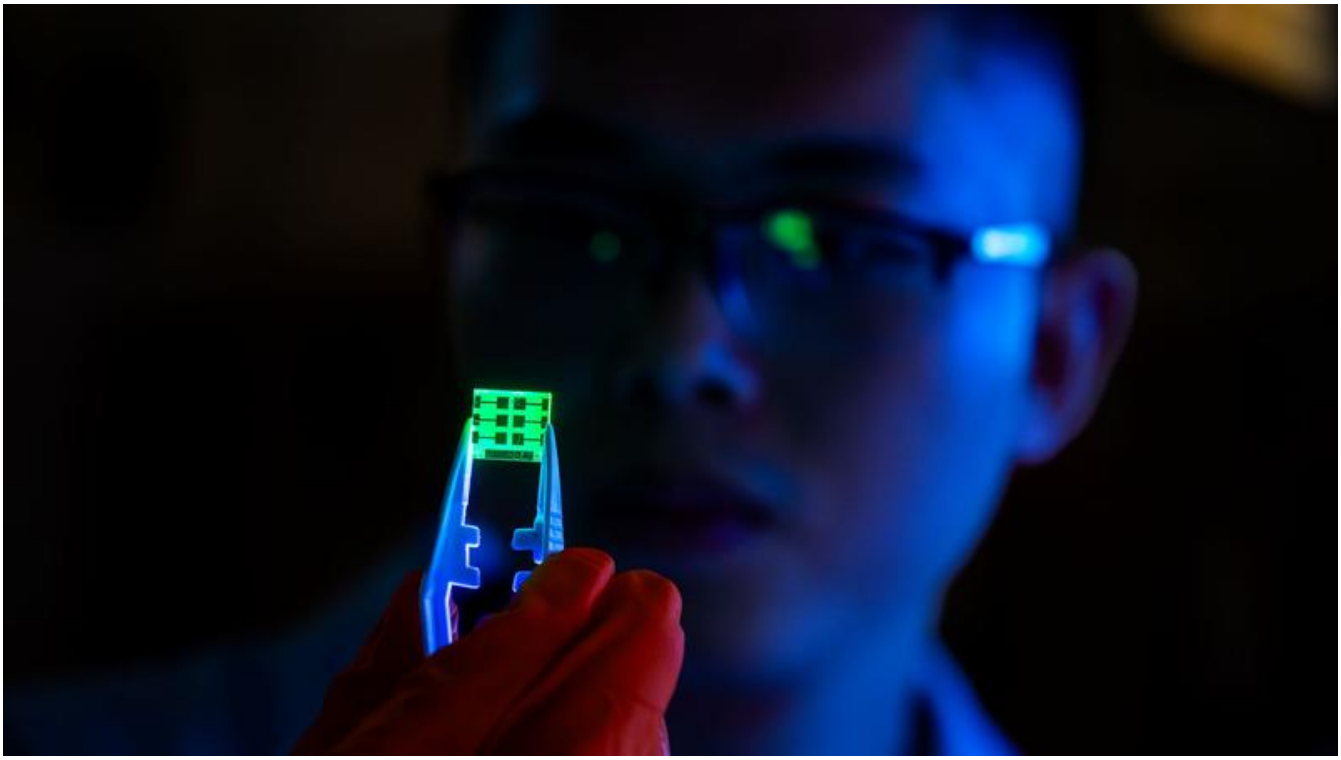

Next generation LEDs may soon be here.
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