Air stable intrinsically stretchable color-conversion layers for stretchable displays

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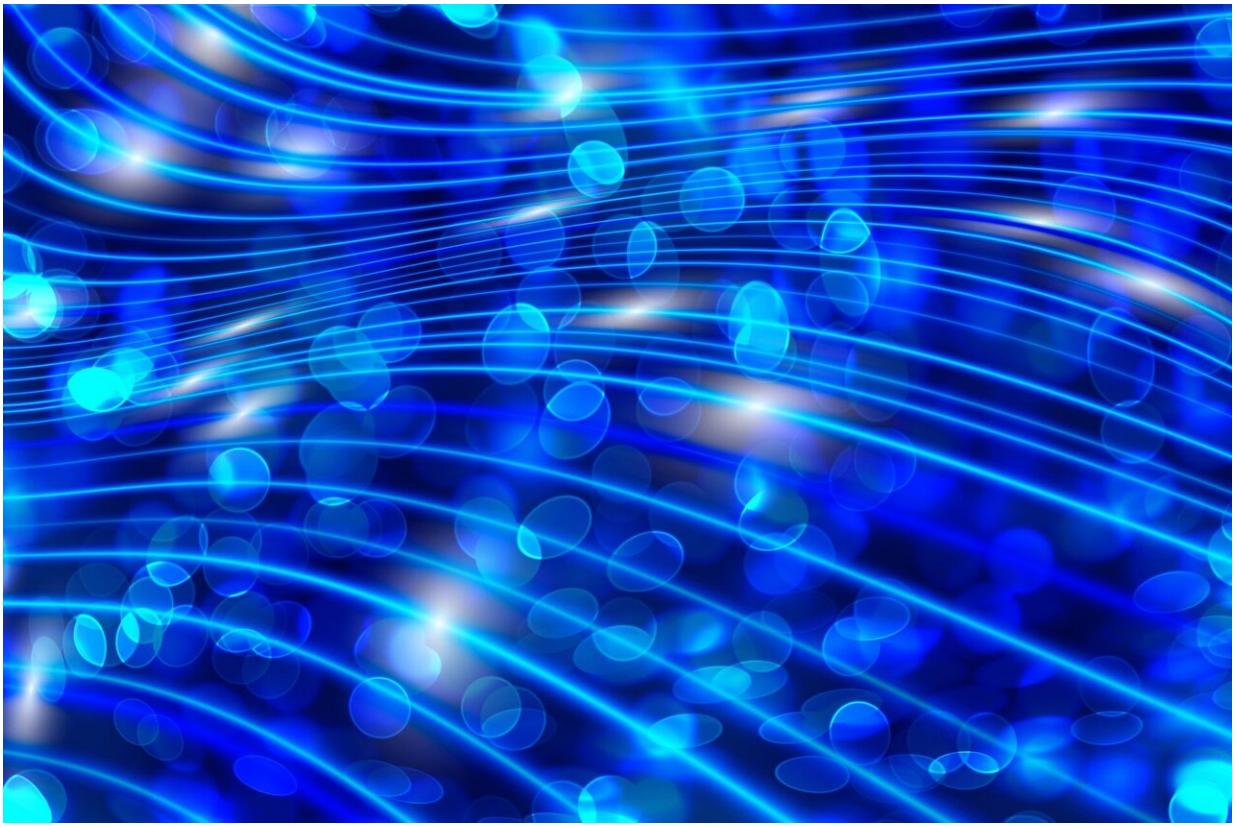

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The development of a stretchable display that can be bent, stretched, and attached to the skin as a free-standing film appeared in science fiction films is expected to be one step closer. The research team led by Prof.

Tae-Woo Lee from Seoul National University announced on the 29th that they have successfully achieved a stretchable color conversion layer (SCCL) using perovskite nanocrystals (PeNCs) and applied it to stretchable displays. This study has made it possible to accelerate the development of next-generation stretchable light-emitting devices.

Recent advances in soft materials and cost-effective solution processing techniques have enabled the fast development of wearable electronics for visualizing signals from varies sensors attached onto human body. The stretchable display, as one of the key components in the body-net wearable system, is the most convenient media for real-time monitoring sensor signals.

The materials that are commonly used for stretchable displays such as light-emitting polymers and quantum dots are unstable and prone to degrade when exposed to moisture and oxygen. The intrinsic properties of materials such as photoluminescence intensity and quantum efficiency will severely deteriorate after the exposure in air, leading to the formation of dark spots in the display. Hence, stretchable light emitting devices require an excellent stretchable encapsulation film to avoid deterioration in the air especially during stretching. New breakthrough through the development of stretchable encapsulation material is in an urgent need.

To solve the problem, a team of scientists from Seoul National University, led by Prof. Tae-Woo Lee have developed an air-stable color conversion layer using PeNCs for stretchable light-emitting devices.

PeNCs, when compared with other light-emitting organic materials and quantum dots, are cost-effective but highly efficient for light-emission. To prevent the degradation of PeNCs, the team used the SEBS (styrene-ethylene-butylene-styrene) as a polymer matrix to improve both stability and stretchability of the film, making it possible to be used as the

stretchable color conversion layer.

PeNCs are effectively encapsulated by the SEBS elastomer matrix that can be stretched upto 100% and recovered when released. Remarkably, the photoluminescence intensity of SCCL increased to 225% after 70 days during the stability test in water; this is the first observation of moisture-assisted surface passivation of PeNCs. The team proposed an air-stable intrinsically stretchable light-emitting device which consists of an intrinsically stretchable electroluminescent device (SELD) integrated with the above-mentioned free-standing SCCL on top without using an encapsulation layer.

This progressive research is published in the prominent journal *Advanced Materials*. The authors explain further: "This work will expand the field of PeNCs that can be applied for stretchable applications and stimulate considerable research on fundamental aspects of PeNCs and furthermore into the practical applications in academia and industries."

More information: Huanyu Zhou et al, Water Passivation of Perovskite Nanocrystals Enables Air-Stable Intrinsically Stretchable Color-Conversion Layers for Stretchable Displays, *Advanced Materials* (2020). DOI: 10.1002/adma.202001989

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