Biaxial tensile testing of stretchable micro-LED display using mechanical metamaterials

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Abstract

Micro-LEDs (Light Emitting Diodes) are tiny inorganic devices, typically less than 100 micrometers in width and only a few micrometers thick. Displays based on micro-LED technology are regarded as the next generation of display innovation, offering significant advantages such as superior color gamut, higher contrast ratios, faster response times, and longer lifespans compared to conventional liquid crystal displays (LCDs).
Stretchable micro-LED displays are fabricated by transferring micro-LED devices onto flexible substrates. By incorporating kirigami-inspired mechanical metamaterials, these displays achieve high stretchability and uniform deformation (1,2). However, the evaluation of their mechanical properties remains challenging due to their unique deformation behavior.

In this study, we developed a biaxial tensile testing method specifically for stretchable micro-LED displays based on mechanical metamaterials. The tensile testing apparatus applies biaxial loads to the display while it remains operational. By measuring strain distribution, we can assess both stretchability and deformation uniformity. This research aims to advance the development of wearable and curved displays, particularly for biomedical applications.

(1) B. Jang†*, S. Won, J. Kim, J. Kim, M. Oh, H.-J. Lee, J.-H. Kim*, "Auxetic Meta-Display: Stretchable display without image distorsion", *Adv. Funct. Mater.* 32, 22 (2022).
(2) Y. Lee†, B. Jang†, H. Song, S. Kim, Y. W. Kwon, H. S. Kang, M. S. Kim, I. Park, T.-S. Kim, J. Jang, J.-H. Kim, J.-U. Park, B.-S. Bae*, "A seamless auxetic substrate with a negative Poisson's ratio of –1", Nature Communications 15, 1 (2024).

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