Design and fabrication of mechanical metamaterials for flexible electronic devices

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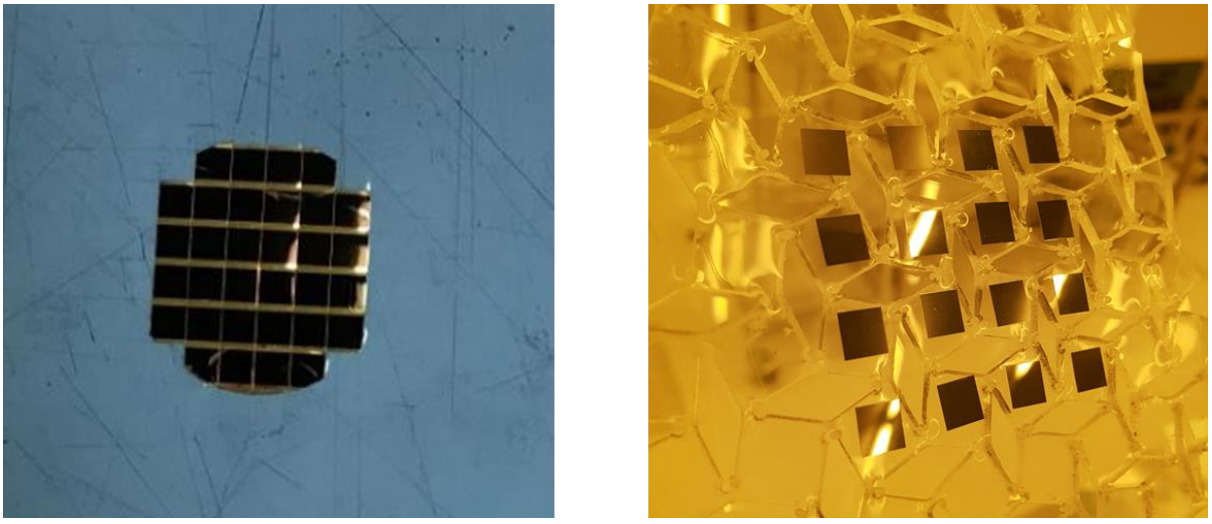
A mechanical metamaterial is artificial structures with mechanical properties defined by their structures rather than their compositions. So far, a lot of examples of the mechanical metamaterials are suggested such as acoustic/phononic metamaterials, materials with negative poisson's ratio, materials with negative longitudinal and volume compressibility transitions and penta mode metamaterials or meta-fluids [1]. In this study, we designed mechanical metamaterials for flexible electronic applications. Using finite element method, kirigami patterns are analyzed for the design of flexible substrates [2]. Numerical simulations demonstrate the deformation of flexible substrates. As a flexible substrate, we use a polymeric sheet and we made kirigami patterns using a laser cutting process. On the mechanical meta-structure of the flexible substrate, we transferred thin devices based on semiconducting materials. This study could help the design and fabrication of flexible electronic devices that can resist various mechanical deformations. In addition, it could enlarge the application of mechanical metamaterials to a various area.

[1] Zadpoor, A. A. Mechanical meta-materials, Mater. Horiz. 3 (2016) 371.

[2] Y. Tang, et. al., Extreme Mech. Lett. 12 (2017) 77-85.



(a) (b)

Fig. 1. (a) Thin film solar cell devices, (b) Thin film devices transferred on flexible substrate designed by kirigami meta-structures.

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