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AN ANALYTICAL MECHANICS MODEL FOR THE ISLAND-BRIDGE STRUCTURE OF STRETCHABLE ELECTRONICS

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Stretchable electronics [1-3] serves as a promising technology with applications to many emerging devices such as flexible displays [4] and solar cells [5], conformable sensors [6], stretchable LEDs [7], implantable transient electronics [8, 9] and electronic eye cameras [10, 11]. The island-bridge structure [10, 11-13] on a soft substrate, as shown in Figure 1, plays an important role in stretchable electronics for the ability to achieve large and reversible stretchability. A key issue in developing such a system is to prevent the island-bridge structure from breaking in use because it is composed of the brittle semiconductor materials (e.g., silicon) which withstand very small strains (~1%). An analytical mechanics model of the island-bridge structure is established and the theoretical solution is obtained. A validated scaling law is found to reveal the dependence of the normalized maximum strain in the island on the prestrain of the substrate, which controls the mechanical failure of the island-bridge structure and provides a theoretical basis for fracture-safe design of stretchable electronics [14].

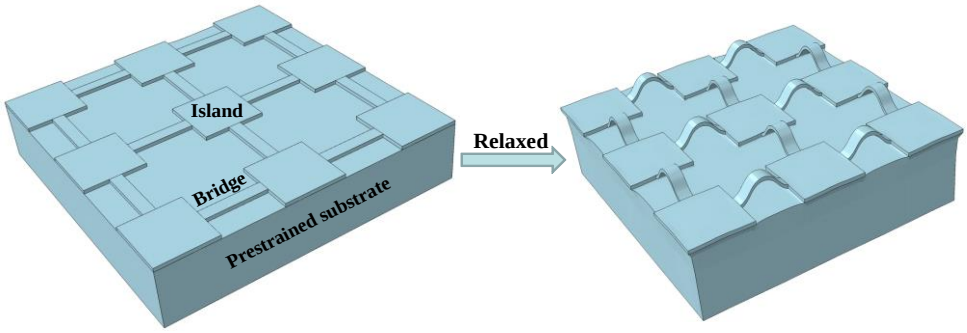

Figure 1 Fabrication of the island-bridge structure.

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