Stretchable and deformable LED configurations based on inkjet-printed chip-bonding technology

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The rapid evolution of printed electronics technology brings a wide spectrum of opportunities to make our surroundings smarter, lighter and more flexible. At the same time, the explosive growth of attention on stretchable and wearable electronics has been made to overcome the limitation of flexibility of a plastic or paper substrate; it allows a novel skin-mountable system that can be ultimately compliant to any kind of surface and endure mechanical stress under the various conditions such as bending, folding, twisting and stretching. Despite crutial impact and numerous works of successful demonstration, most stretchable and deformable forms of electronic systems depend on the specific technique: transfer-printing, which restricts the functionality and applicability of systems. Consequently, there is a pressing need to develop a new appproach for in-situ device integration directly onto stretchable substrates.

In this work, we introduce a novel in-situ inkjet-printing-based chip-bonding technology. Like a conventional flip chip bonding technology, commercially available LED chips (1 mm x 0.9 mm x 0.2 mm) are successfully bonded directly onto the soft substrate in precisely controlled configuration using a placement machine and a facile inkjet-printing technique. In addition, we simply demonstrate all-printed stretchable and deformable LED arrays combined with prestretching process. The technology presented here would show the potential of printable and stretchable hybrid systems, where commercially addressable functional chips or dies can be directly integrated.

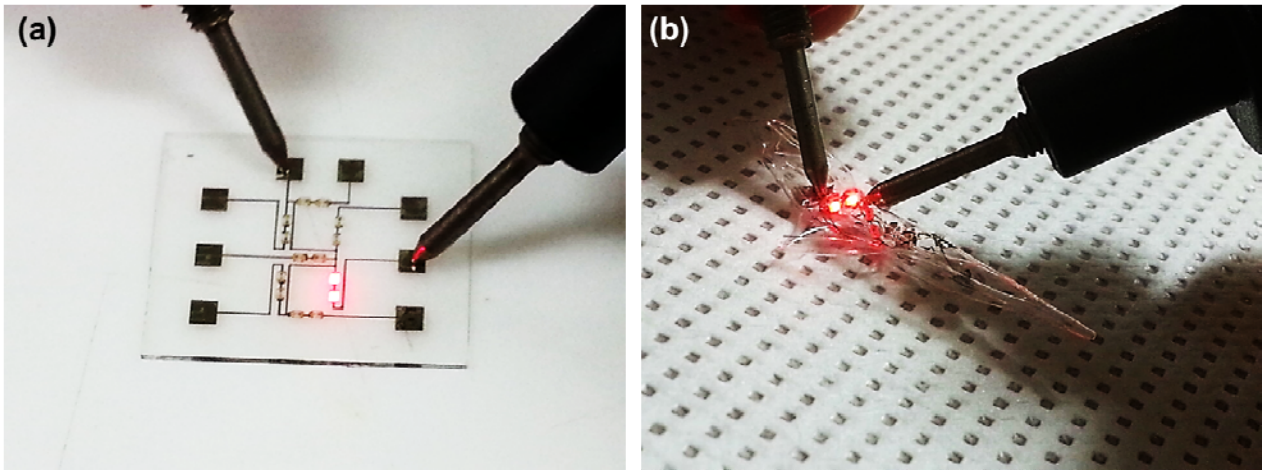

Fig. 1. (a) Demonstration of LED chips onto the soft substrate based on the inkjet-printed chip-bonding technology. (b) Demonstration of deformable LEDs in rolled condition.

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