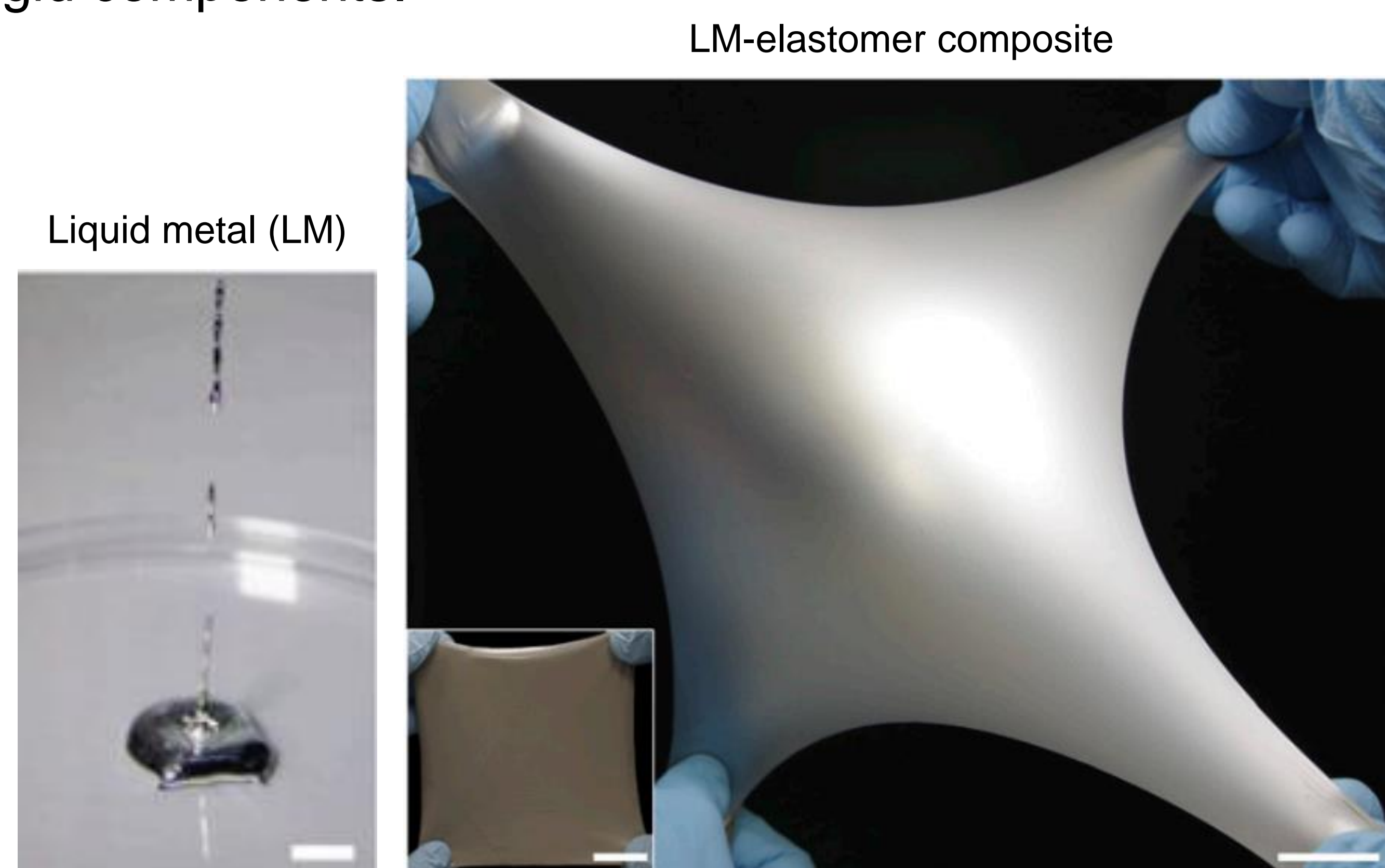


Luis Granadillo, Ravi Tutika , A. B. M. Tahidul Haque, Michael D. Bartlett (advisor)

# Integration of Soft Electronics with Rigid Components

## Background

Stretchable electronics are necessary to improve the compatibility between humans and electronic devices. One approach to developing stretchable electronics is utilizing a composite material composed of a gallium-based liquid metal (LM) alloy (eutectic Ga-In, EGain) embedded in an elastomer (SIS copolymer) as soft circuitry. To match the functional capacity of traditional rigid electronics, hybrid circuits can be developed by integrating rigid components into soft, stretchable substrates. However, the integrity of the interconnect between the rigid and soft components suffers due to a difference in stretchability. Here we show a procedure to create robust connections between a selectively conductive liquid metal-elastomer composite and rigid components.



Scale bars: 25 mm

Bartlett, M.D. *et al.* PNAS 2143–2148, 2017

## Objectives

- Develop methodologies to improve the robustness of electrical connections between rigid surface mount technology (SMT) circuit components and electrical traces in a liquid metal-polymer composite
- Develop a prototype electrical device that utilizes the stretchable quality of the liquid metal-polymer composite

## Electrical Interfaces

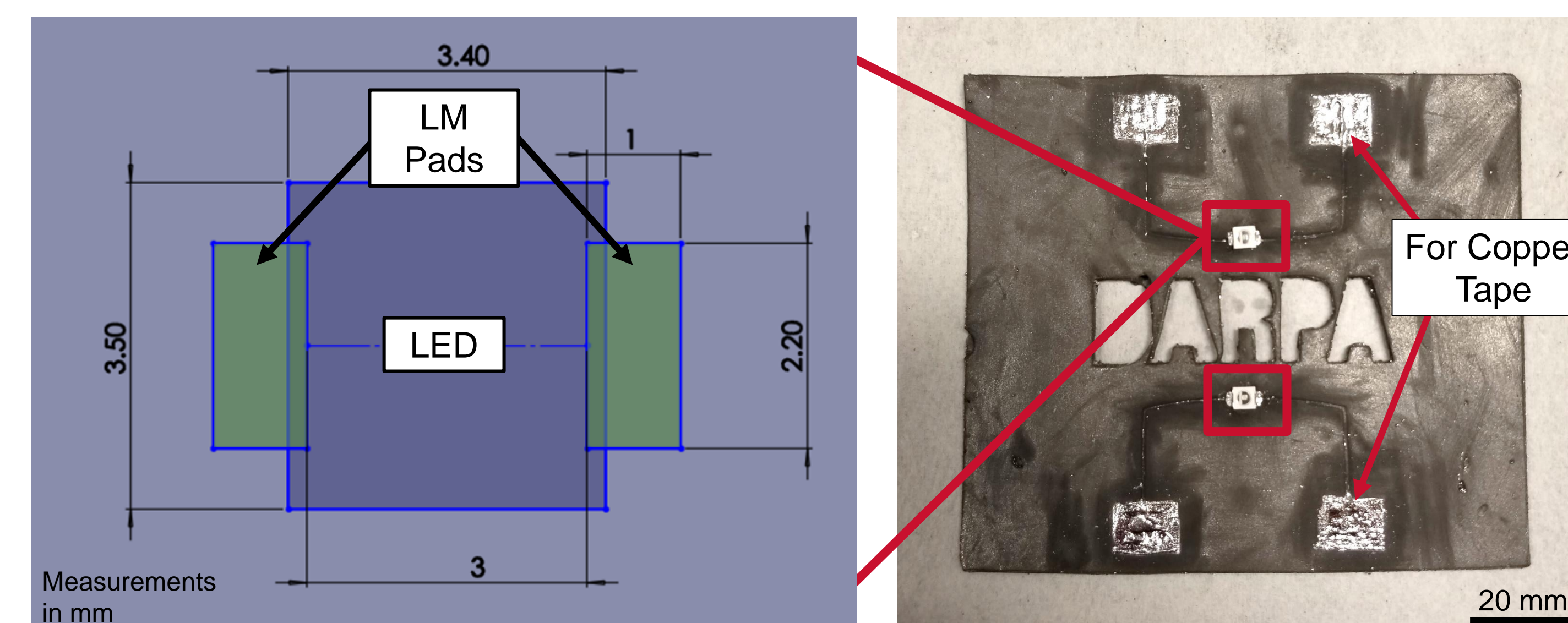
**Between rigid components and the elastomeric circuit:**

- LM-Cu alloy paste
- 7 vol% of 1μm Cu particles mixed into LM

**Connections to other electrical components outside the elastomeric circuit:**

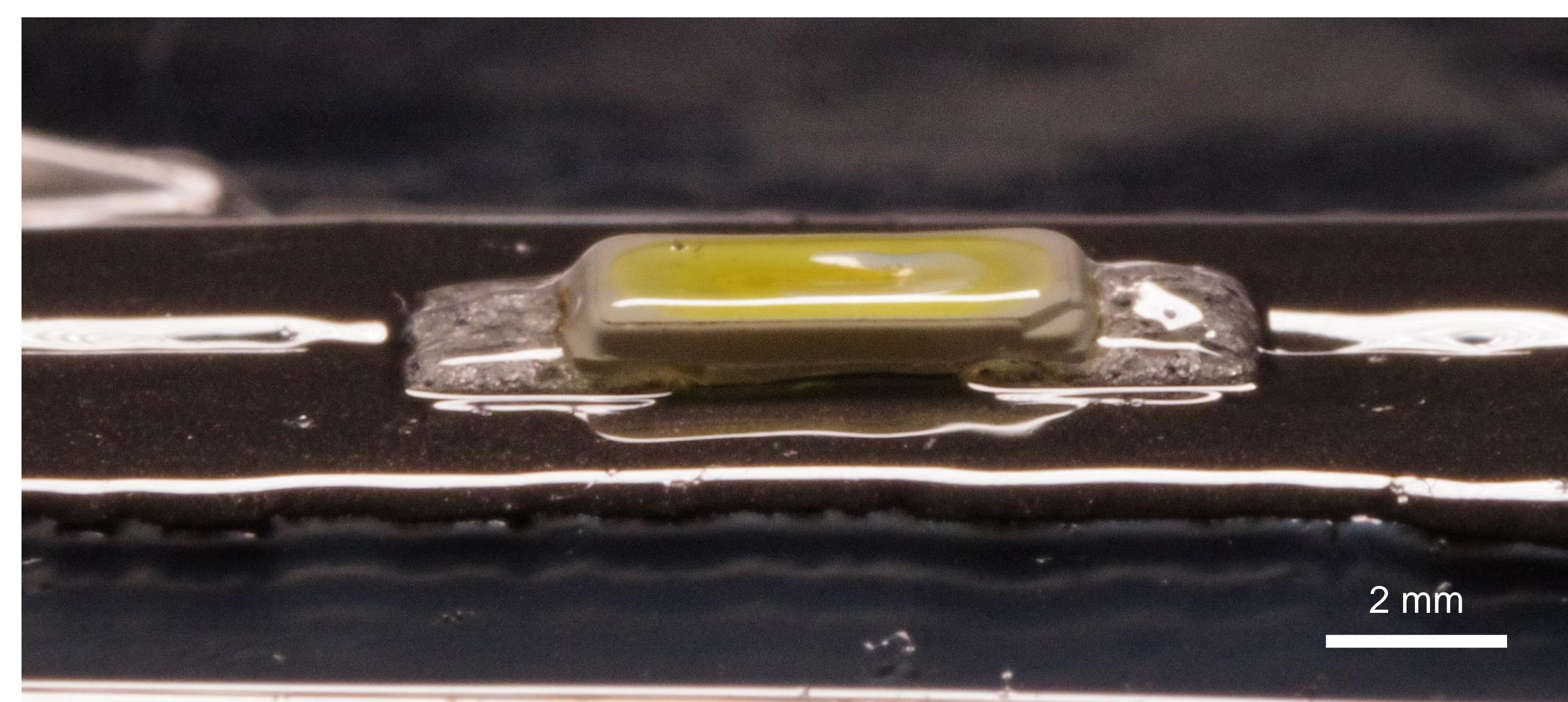
- Copper foil tape with conductive adhesive (3M)
- LM-Cu paste is placed on top of several conductive traces to contact the copper tape.

## Component Integration

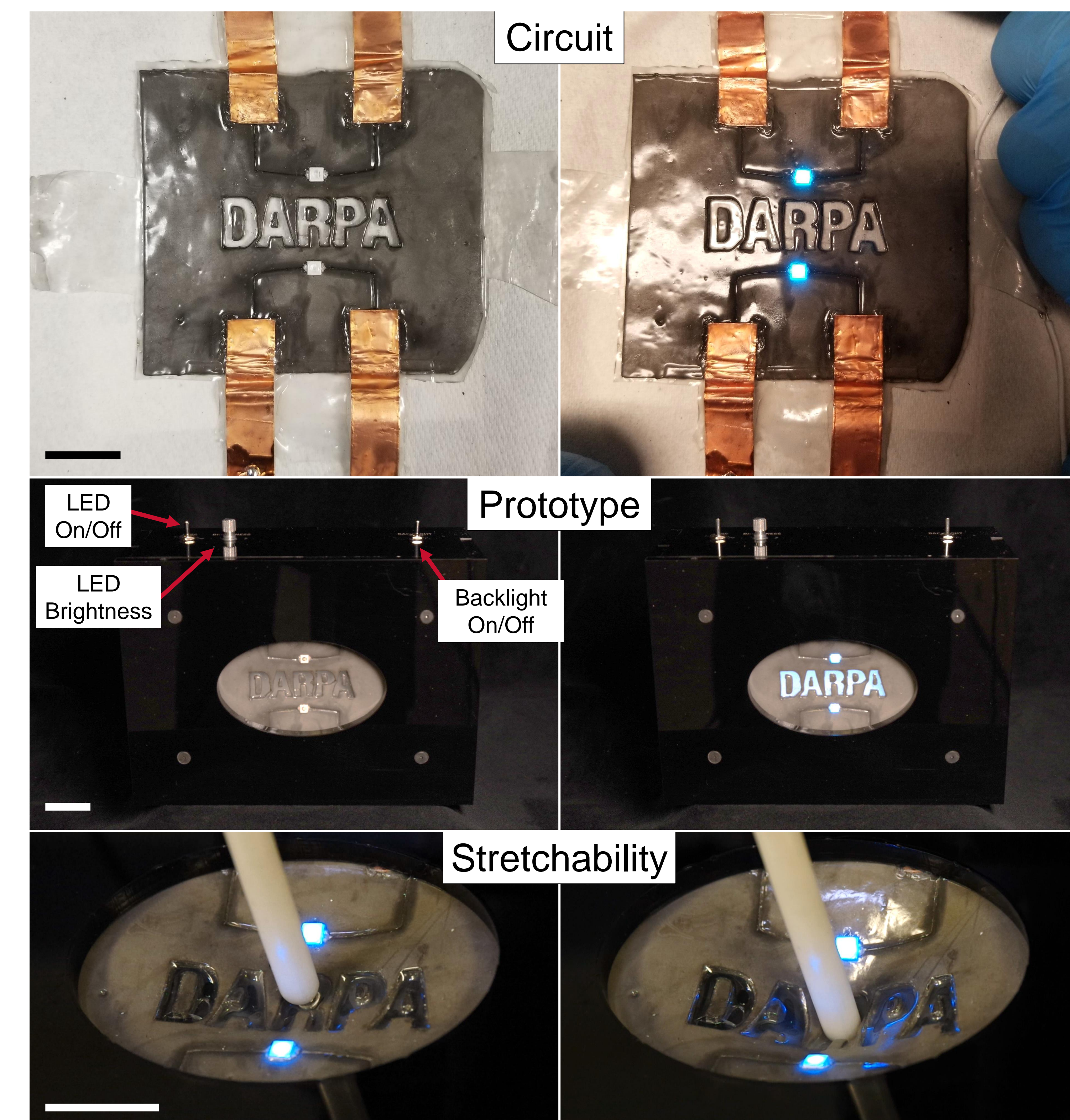


## Encapsulation

- Circuit is encapsulated on both sides using SIS to secure the component into the LM-Cu paste
- SIS is used to ensure a good bond is formed between the elastomer and the encapsulating film



## Circuit and Stretchability Test



Scale bars: 20 mm

## Conclusion and Future Work

- Robust integration of rigid electrical components and soft, stretchable circuitry was demonstrated
- Further study on:
  - characterization and improvement of range of motion of electrical connection
  - increasing the density of components on soft circuitry

