Weill Cornell Medicine

Scalable Production of Flexible Electronics for Anatomical Mapping and Sensors

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Background & Unmet Need

- Cardiac arrhythmias such as atrial fibrillation (A Fib) can be treated with radiofrequency catheter ablation
- Electroanatomical mapping is used to identify the cardiac circuits triggering arrhythmias ahead of the radiofrequency catheter ablation procedure
- Current electroanatomical mapping systems are limited due to rigid basket catheter designs which do not conform to complex atrial or ventricular anatomy
- Flexible electronics can accommodate repeated strain and conform to patient anatomy, making them ideal for use in anatomic sensors and actuators
- However, current production of flexible electronics relies on novel material formulations and production within clean rooms, which limit scalability
- **Unmet Need:** There is a need to develop flexible and scalable multielectrode arrays for electroanatomical mapping and sensing applications

Technology Overview

- **The Technology:** A method for scalable generation of soft robotic sensor arrays (SRSA) with the ability to conform to anatomical structures using a conventional laser cutting tool
- The inventors leverage the thermal masking principle to selectively remove insulation of electronic circuits, allowing for production of SRSAs with increased flexibility
- **PoC Data:** Postprocessing of flex-printed circuit boards (PCBs) using this method led to increased flexibility of SRSAs based on stress strain assessments
- SRSAs successfully mapped four 3D printed left cardiac atria with an average of 85-90% conformability between the sensors and atrial surface
- SRSAs maintained mechanical integrity based on the ability of the array to withstand 100 cycles of actuation without reduction of performance

Inventors:
Simon Dunham
Bobak Mosadegh
Varun Kashyap
Alexandre Caprio
Tejas Doshi

Patents:
US Application Filed
EP Application Filed

Publications:
Lahcen et al. *Micromachines (Basel)*. 2023.
Kashyap et al. *Adv. Eng. Mater.* 2021.
Kashyap et al. *Science.* 2020.

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Technology Applications

- Production of soft robotic sensor arrays for use in electroanatomical mapping, such as cardiac mapping
- Large scale production of low-cost stretchable electronics such as those used in diagnostic implants, health monitors, and sensory skin for medical robotics

Technology Advantages

- Integrates soft robotics with flexible electronics to allow for unrivaled anatomical conformity
- Allows for excellent electronic stretchability without requiring novel materials
- This method can be readily applied to a wide variety of geometry actuator/sensor arrays
- Can easily scale to mass production at a low cost

Supporting Data / Figures

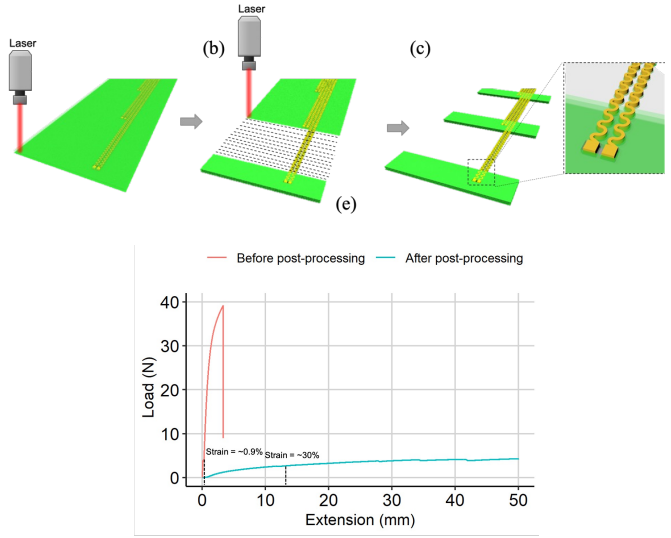

Figure 1: Top: Schematic of use of thermal masking principle to selectively remove insulation of electronic circuit boards **Bottom:** Circuit boards demonstrate increased stretchability in stress-strain curves after post-processing.

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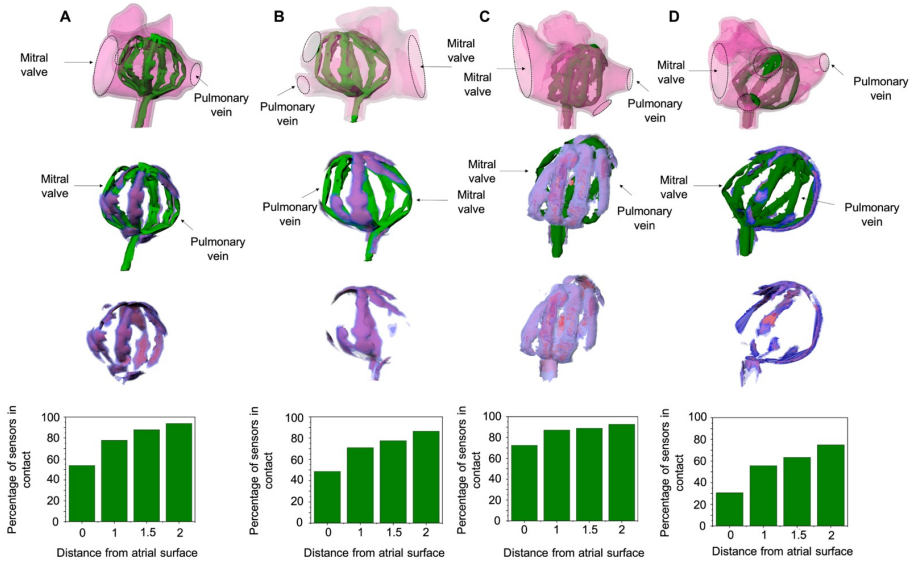

Figure 2: The ability of soft robotic sensor arrays (SRSAs) to conform to atrial surface was assessed in 3D printed left atria of four patients (labeled A to D). The distance of the SRSAs from the atrial surface has been labeled with a colorimetric spectrum of red to blue for 0mm to 2mm, respectively. The percentage of sensors in contact with the atrial surface has been plotted at the bottom of each column.

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