Docket #: S18-163

Laser patterned stretchable electronics

Stanford researchers have developed a fabrication method for laser patterning stretchable electronics. They use an iron containing polymer precursor with a graphene nanofiber network embedded in polystyrene block poly(ethylene-ran-butylene)-block polystyrene (SEBS) elastomer matrix. Laser patterning enhances strain performance by creating dense interconnected graphene nanofibers. The laser patterned material, which maintains excellent conductivity during stretching, is a fundamental building block (e.g., interconnect, electrode, sensor, etc.) for stretchable electronics. Using the process, the Bao Research Group fabricated a successful, tissue mimicking, stretchable, neurochemical biointerface called NeuroString, as well as a working stretchable printed circuit board. The easy, effective, and versatile patterning technique reduces cost and lends itself to large-scale fabrication of stretchable electronics.

Stage of Development - Proof of Concept Prototype/ In Vivo Testing
Using their fabrication process the Bao Research Group created and tested a tissue mimicking, neurochemical biointerface called NeuroString. NeuroString was highly effective in the study of neurotransmitters (serotonin and dopamine) released by pharmacological compounds (cocaine) in mice. Immunohistology studies for NeuroString in mouse brain tissue showed minimal adverse tissue response, higher biocompatibility, and overall better results than state of the art rigid silica encapsulated carbon fiber electrodes. Publication is forthcoming.

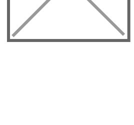

Figure 1 Laser printed "**NeuroString**" for brain and gut neurotransmitter sensing.

A) Schematic of a soft brain implant for neurotransmitter sensing. B) Illustration of NeuroString implanted in brain and colon. C) 3 channel NeuroString. D) NeuroString implanted in mouse. E)X-ray computed tomography of NeuroString in mouse colon.

Additional related upcoming stretchable electronics innovations from the Zhenan Bao Research Group include:
• A new formulation of PEDOT: PSS for direct photopatterning with maintained high conductivity and intrinsic stretchability. **Stanford docket S19-101.**

• A process for direct photo-patterning electronic polymers that improves device density of elastic circuits over 100x. **Stanford docket S19-138.**

• A stretchable transparent conductor device based on photo crosslinked PEDOT:PSS with high electrical conductivity, stretchability, and directly photo patternable. **Stanford docket S20-489.**

Applications

- Neurochemical monitoring:
  - Brain-gut interaction
  - Gut microbes
  - Glucose sensing
  - Whole body molecular monitoring
- Wearable devices
- Stretchable, flexible electronics

Advantages

- Cost effective, rapid, large-scale fabrication method.
- Versatile, easy, and effective.
  - Meter scale size and resolution down to 20 micrometers.
  - Molecular design for diverse health-monitoring functions.
  - Biocompatible with superior properties – NeuroString has high-level supercapacitive response, known catalytic activity, and high mechanical compliance in bending stretching and twisting.

Patents

- Published Application: 20220095963

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