

**Docket #:** S11-468

# **Process of Depositing Stretchable, Elastic, Transparent, and Conductive Carbon Nanotube Films on Silicone Substrates**

Researchers from Stanford University have developed a novel method for generating stretchable, transparent, and conductive films. The creation of the film is a simple two step process. After spraying single-walled carbon nanotubes on a silicon substrate, the substrate can be stretched in different directions, thus causing the nanotubes to conform to a spring-like structure. Once this process is completed, these flexible films can accommodate strains of up to 150 percent and demonstrate conductivities of over 1000 Siemens/centimeter. This is the highest conductivity reported in the literature for a conductor that can be stretched over 100 percent. There are extensive pressure-sensing applications for this invention; it can be used as electronic skins for prosthetic limbs and on interactive displays.

**Chemical Engineering postdoctoral fellow Darren Lipomi demonstrates the stretchable, artificial skin in the lab.**

## **NPR "All Tech Considered" Feature**

["Just Like Human Skin, This Plastic Sheet Can Sense And Heal"](#), April 11, 2016

## **Applications**

- Human-interactive, electronic skin for prosthetic limbs and artificial intelligence systems
- Solar modules that have curved surfaces
- Sensors

- Pressure/Touch Sensors for Interactive Displays
- Mechanical Sensors for biomedical devices

## Advantages

- Simple
  - Two-step process to create film
    - Spray-deposited with a commercial airbrush
    - One-time application of Strain-and-release to the substrate
- Transparent
- Flexible and Conductive
  - Film able to accommodate strains of up to 150 percent and demonstrates a conductivity of 1000 Siemens/centimeter
    - Highest conductivity reported in literature for a conductor that can be stretched more than 100 percent
- Fracture-resistant

## Publications

- Lipomi, Darren, Michael Vosgueritchian, Benjamin Tee, Sondra Hellstrom , Jennifer Lee, Courtney Fox, and Zhenan Bao, [Skin-like Pressure and Strain Sensors based on Transparent Elastic Films of Carbon Nanotubes](#) , *Nature Nanotechnology*, 6, pp. 788–792, Published online 23 October 2011: 1-5, DOI:10.1038/nnano.2011.184
- Bergeron, Louis, [Stanford Researchers Build Transparent, Super-stretchy Skin-like Sensor](#), Stanford University News Service, published online 24 October 2011.
- Fyffe, Steven, ["Nanotube Springs Stretch Skin-Like Sensor"](#), Uploaded by Stanford University on 21 October 2011.

## Patents

- Published Application: [20140109695](#)
- Issued: [9,212,960 \(USA\)](#)

## **Innovators**

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