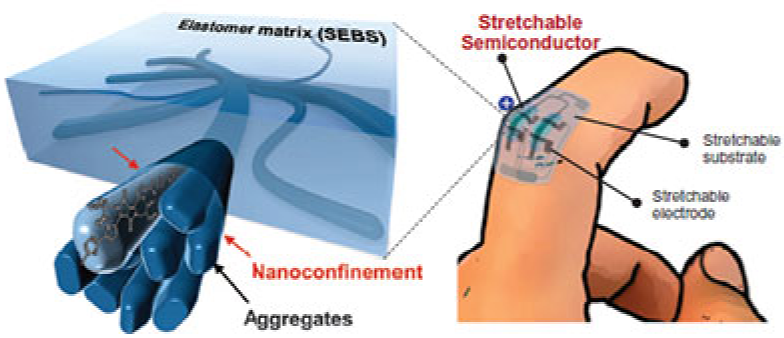
Docket #: S15-438

Stretchable Semiconductor via Polymer Blending

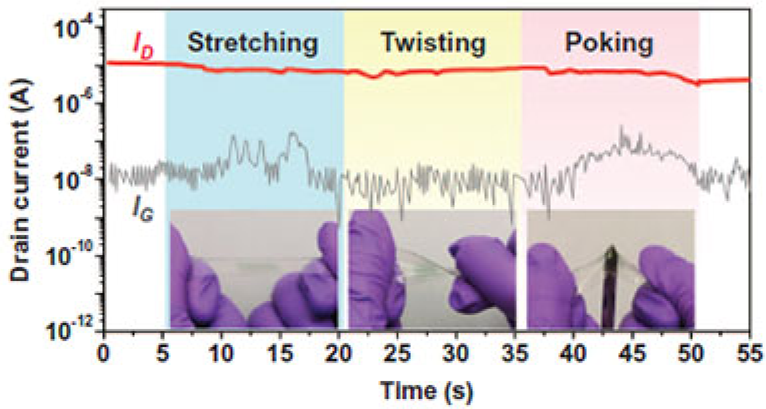
Stanford researchers have created a highly stretchable organic semiconductor by blending high mobility semiconducting polymers with an elastomer. The CONPHINE (conjugated polymer/elastomer phase separation induced elasticity) semiconducting film can be stretched up to 100% strain without affecting mobility, retaining values of 1 $cm^2\ V^{-1}s^{-1}$, comparable to that of amorphous silicon. The charge carrier mobility of these durable films are maintained even after 100 times stretching cycles under 100% strain - making CONPHINE films excellent candidates for wearable technology, biocompatible devices, and electronic skins for robotics or prostheses.



3D morphology of the polymer semiconductor - The increased polymer chain dynamics under nanoconfinement reduces the modulus of the conjugated polymer and delays the onset of crack formation under strain, without affecting charge mobility.

Stage of Research

Scientists have fabricated stretchable thin film transistors using the CONPHINE method. The fully stretchable transistors exhibit high stretchability with minimal change in drain current even when poked with a sharp object.



CONPHINE TFT drain current under stretching, twisting, and even poking by a sharp object.
The robust device maintained performance over 1000 repeated stretching cycles to 25% strain at four cycles per second (the general range for applied strains in most wearable electronic applications). Researchers also tested a skin-like finger wearable driver for a light-emitting diode to demonstrate potential use for wearable electronics.

Applications

- Stretchable semiconductor devices for:
  - Wearable and mobile platforms
  - Biocompatible devices and health monitoring
  - Electronic skins for robotics and prostheses

Advantages

- Excellent electronic performance under stretching:
  - Charge carrier mobility values same or slightly higher compared to that of a neat conjugated polymer thin film.
  - **Durable** - At high strains up to 100%, the mobility values of blending films do not decrease and are maintained around 1 cm2 V-1s-1 (3x the neat conjugate polymer and 100% better than any average mobility previously reported for organic semiconductors under high strain).

Publications

- Xu, Jie, Sihong Wang, Ging-Ji Nathan Wang, Chenxin Zhu, Shaochuan Luo, Lihua Jin, Xiaodan Gu et al. "Highly stretchable polymer semiconductor films through the nanoconfinement effect." Science 355, no. 6320 (2017): 59-64.

Patents

- Published Application: 20170331045
- Issued: 10,741,766 (USA)

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