Docket #: S22-405

Stretchable dielectric design for low-voltage driven transistor and all-solid-state intrinsically stretchable synaptic transistor for electronic skin

Stanford researchers in the Bao lab have developed a new fabrication method to create stretchable transistors for electronic skin. It produces a soft, stretchable material capable of sensing pressure, temperature, strain, and more. This technology can operate at low voltage which makes it safe to use on the human body.

One aspect of this invention is a tri-layer dielectric stack that can reduce the driving voltage of an intrinsically stretchable transistor. The tri-layer dielectric boosts capacitance and greatly improves dielectric strength. Current technologies for intrinsically stretchable organic electronics require high operation voltage, which results in safety issues and high power consumption. Previous stretchable transistors have also had a tradeoff between high capacitance and high transistor performance, while this technology includes both.

Another aspect of this invention is a solid-state synaptic transistor. The researchers used the synaptic transistor to fabricate an all-solid-state, stretchable synaptic transistor array which maintained performance under 50% strain. Previous synaptic transistors have included either liquid or gel components, creating instability, or rigid materials, preventing the technology from conforming to tissue. This array also demonstrated water resistance, which could allow it to be used for medical purposes.

Stage of Development

- Lab Prototype tested

Stanford News
"Soft 'e-skin' generates nerve-like impulses that talk to the brain" (May 18, 2023)

Figure:



Figure description: E-skin developed in the Bao lab capable of running at low voltage
Image credit: Jiancheng Lai and Weichen Wang of Bao Research Group at Stanford University

Applications

- Low-voltage driven soft electronics for wearable devices
- Bio-interface and neuromorphic devices developments

Advantages

- **Tri-layer dielectric:**
  - Reduces the driven-voltage of stretchable transistors for improved safety and lower power consumption
  - Low operation voltage and high carrier mobility
  - Record-low subthreshold swing for stretchable transistor
  - Improved dielectric capacitance and strength
- **Synaptic transistor:**
  - All solid materials for more water resistance
  - Improved environmental stability
  - High stretchability without any liquid or gel components

Publications

- Weichen Wang, et al. Neuromorphic sensorimotor loop embodied by monolithically integrated, low-voltage, soft e-skin. Science 380, 735-742(2023).

Innovators

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