Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Steven Lathers

Jeffrey LaBelle

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

3D Printed Flexible Sensors and Fabrication Methods

It is estimated that there are two million people in the United States that have lost a limb and another 185,000 each year that will lose a limb. Artificial limbs, or prosthetics, can restore some normal function but are expensive and sometimes not covered by insurance. Touch sensors are often used to alert a user when the prosthetic has come into contact with an object. Typical touch sensors include strain gage sensors which are bulky and expensive. This can cause unnecessary mass which decreases fine motor functions in upper limb prosthetics. Thick/thin film sensors are also utilized, however, they do not have a human skin-like feel or appearance, are complicated and expensive to manufacture, and are difficult to implement on a prosthetic.

Researchers at Arizona State University have developed flexible pressure sensors for use in prosthetic feedback systems that can be 3D printed or molded. They can be easily printed or molded in different sizes to create custom designs, layouts or patterns for pressure sensor feedback systems. In the 3D printed form, these sensors have a thickness and feel similar to human skin. Simple fabrication techniques means that the sensors can be tailored to user specific geometries. Cyclic voltammetry results show an operating voltage of -0.2V with an elastic modulus of 1.83x10-4GPa to 6.0x10-4GPa. Force testing showed that the sensors are able to achieve between17.03Pa (the pressure value for a light touch) and 51.09kPa.

These sensors are able to overcome many of the challenges facing prosthetic sensors and present a major achievement in the prosthetic industry.

Potential Applications

- Prosthetic sensors
- Tissue scaffolding
- Anatomic molds for veterinary research
- Surgical and patient training
- Tissue regeneration guide

- Prosthetic hands/fingers

Benefits and Advantages

- Low cost, lightweight but strong materials that can be 3D printed or molded
- Materials are FDA compatible
- Able to be custom-built for user-specific sizes
- Elastic modulus of 1.83x10-4GPa to 6.0x10-4GPa
- Capable of detecting pressure values as low as 17.03Pa and up to 51.09kPa

o Detecting values well below the light touch threshold allows for detection of early onset contact with an object

- Simple fabrication techniques
- Look and feel of human tissue
- Designed to meet the demands of daily activities

For more information about the inventor(s) and their research, please see Dr. La Bellel's laboratory webpage