NOVEL POLYMER DEVICE FOR IMPROVING CONTROL OF IMPLANTABLE DEVICES

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T-021492

Published date: 7/21/2026

Value Proposition*: Approach to modulating the stiffness of PEDOT:PSS within an electrolyte solution through the application of mild and short voltage.*

Technology Description

Researchers at Washington University in St. Louis have developed a unique, dynamic platform with electricity-conducting biomaterials in which stiffness can be modulated by applying voltage. Biomedical devices are designed for the diagnosis, prevention, mitigation, and treatment of diseases. The materials that make up these biomedical devices interact directly with biological systems. While biological systems are dynamic and constantly changing, particularly in their mechanical properties, the materials engineered for medical devices are typically designed to have static stiffness. These medical devices often fail to interface with and adapt to the dynamically deforming tissues of the body. Additionally, standard electrophysiological signal recording electrode materials, such as silver/silver chloride, stainless steel, and platinum, exhibit static and significantly high stiffness, making it challenging to conform and adapt to soft and dynamic biological tissues.

This PEDOT:PSS system offers novel tunable stiffness that dynamically matches tissue deformations, providing a softer and more adaptable interface. This capability also makes it suitable for various implantable medical devices, including catheters, stents, and signal-recording probes, enabling the design of medical devices that can effectively interact with dynamic biological systems. The platform can help researchers learn more about the potential to use conducting polymers to study mechanobiology and to study the effect of stiff environments on cells, which play a role in fibrosis and some types of cancer.

Stage of Research

Have used commercially available Heraeus Clevios PH1000 PEDOT:PSS with an ionic liquid, 4-(3-butyl-1-imidazolio)-1-butanesulfonic acid triflate, as a gelling agent. They demonstrated that charge injection can be linearly tuned by voltage applications using electrochemical analysis. This was also confirmed by ultraviolet-visible light spectroscopy, which is commonly used to characterize the redox states of PEDOT:PSS.

Publications

- Jae Park, Tianran Liu, Somtochukwu Okafor, … Alexandra Rutz. Characterizing PEDOT:PSS for Electronic Control of Stiffness. ChemRxiv. 29 December 2025. DOI: https://doi.org/10.26434/chemrxiv-2025-1qw4z

Applications

- Implantable devices
- Mechanically stimulating cells

Key Advantages

- Offers multiple available stiffness states so that more complicated actions of the devices can be accomplished
- Allows for the development of implantable devices with enhanced control
- Provides no need for continuous voltage

Patents

Patent pending

Related Web Links – Alexandra Rutz Profile; Rutz Lab