3D PRINTED HYDROGEL BIOELECTRONIC DEVICE

Liu, Tianran, Okafor, Somtochukwu, Rutz, Alexandra
Weilbaecher, Craig

T-020112

Published date: 3/3/2026

Value Proposition: *New bioelectronic device that can stimulate, record, or sense for medical bioelectronic applications.*

Technology Description

Researchers at Washington University in St. Louis have developed a bioelectronic device that incorporates polymer electrodes into a 3D hydrogel scaffold. Current bioelectronics are made of metal (Cochlear implants, pacemakers, brain monitoring devices) and are bulky. Traditional fabrication methods typically involve photolithographic microfabrication in cleanroom – depositing layers – layer-by-layer using mask – expensive and laborious.

This technology presents a new type of bioelectronic device – one is that is potentially better suited for cellular and tissue interfacing, both in vitro and in vivo. In vitro, the device provides three-dimensional culture conditions (as opposed to current state-of-art in planar or needle electrode arrays), making it ideal for organoid or tissue culture where the 3D printed porous electrode may serve to measure some biological phenomena or stimulate the tissue for enhanced culture (e.g. promote or accelerate differentiation of stem cells). In addition, this device can be used in tissue repair or regeneration where the electrode provides stimulation to promote or accelerate repair.

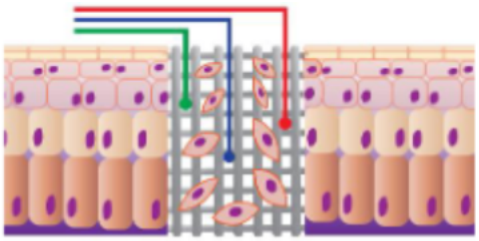

Figure 2 *Bioelectronic scaffolds (gray) will be fabricated to sit within nerve defects and are capable of delivering electrical stimulation through the entire defect volume.*

Publications

Anna P. Goestenkors, Justin S. Yu, Jae Park, Yuqing Wu, Cielo J. Vargas Espinoza, Lianna C. Friedman, Somtochukwu S. Okafor, Tianran Liu, Suman Chatterjee, Avishek Debnath, Barbara A. Semar, Cayleigh P. O'Hare, Riley M. Alvarez, Srikanth Singamaneni, Baranidharan Raman, Alexandra L. Rutz. bioRxiv 2025.05.25.655149; doi: https://doi.org/10.1101/2025.05.25.655149

Applications

- Bioelectronics
- Endogenous tissue repair or regeneration

Key Advantages

- Soft, hydrated porous materials
- Incorporates electrodes into 3D hydrogel structure

Patents
Patent pending

Related Web Links – Alexandra Rutz Profile; Rutz Lab