Three-dimensional (3D) Nanoelectronic Scaffolds (nanoES) for Synthetic Tissue Engineering
Technology #15383

Applications

Macroporous, freestanding nanoelectronic scaffolds (nanoES) are particularly suitable for biomedical prosthetics, cellular biophysics studies, and the engineering of functionalyzed tissues. Additionally, nanoES-based culture systems provide the means for three-dimensional (3D) neural and cardiac tissue models for drug-based therapeutic and developmental assays.

Problem Addressed

Both cellular biophysics and regenerative medicine rely on the merging of electronics with biological and synthetic tissues. Such integration has been developed on a two-dimensional (2D) scale and used to probe electrical activity at the surface of biological tissues. However, it has not yet been possible to provide spatiotemporal monitoring of cells throughout synthetic, biocompatible 3D scaffolds. Macroporous, freestanding nanoES can be used alone or in addition to other biocompatible scaffolds to mimic the structure of natural tissue. They are equipped with sensory capabilities that allow for the real-time monitoring of local intra- and extracellular electrical activity and pH throughout 3D cultures of neural and cardiac tissues.

Technology

NanoES are freestanding, flexible 3D structures assembled via the stepwise integration of electronic and biological building blocks. Planar lithography is used to pattern and deposit silicon nanowire field-effect transistors (NWFETs), which serve as the sensor elements of the scaffold and are capable of detecting extra- and intracellular potentials with subcellular resolution. NWFETs are subsequently arranged and integrated into freestanding 3D structures (nanoES) via self-organization, manual folding or rolling of planar mesh matrices, and/or by hybridization with synthetic or natural extracellular matrix (ECM) components. Cells are subsequently seeded into the nanoES, affording opportunities for developmental modification via growth factors and the spatiotemporal monitoring of electrochemical activity in the context of therapeutic assays.

Advantages

- Provides spatiotemporal monitoring of cells throughout 3D scaffolds
- Free-standing, flexible, biocompatible scaffolds with high porosity
- Can detect extra- and intracellular potentials throughout 3D tissues with subcellular resolution

Categories For This Invention:
Electronics & Circuits
Materials
Micro & Nanotech
Nanomaterials
Nanowires (Micro & Nanotech)
Life Sciences
Biomaterials
Composites
Micro/nanoparticles (Biomaterials)
Clinical Applications
Tissue Engineering
Research Tools
Micro/nanoparticles (Research Tools)

Intellectual Property:
Scaffolds comprising nanoelectronic components for cells, tissues, and other applications
Issued US Patent
Scaffolds comprising nanoelectronic components for cells, tissues, and other applications
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Publications:
Macroporous Nanowire Nanoelectronic Scaffolds for Synthetic Tissues
Nature Materials
26 AUGUST 2012
Merging Nanoelectronics into 3D Engineered Human Tissues
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External Links:
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