Low-cost, versatile, and highly reproducible microfabrication pipeline to generate 3D-printed customised cell culture devices with complex designs

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Lay Summary of Research on Customized Cell Culture Devices

Background

In biomedical research, studying cells in controlled environments is crucial. Traditionally, scientists have faced challenges with standard cell culture methods that don't allow precise control over the conditions in which cells are grown. To address these challenges, researchers have developed advanced techniques to create customised environments for cell cultures. This study introduces a new high-resolution, cost-effective, and versatile method to produce custom 3D-printed cell culture devices.

What Are Cell Culture Devices?

Cell culture devices are tools used by scientists to grow cells outside their natural environment, such as in a lab dish. These devices need to mimic the natural conditions of cells as closely as possible to provide accurate data for research. Conventional devices often lack flexibility and customization, making it hard to control the cells' environment precisely.

The New Microfabrication Pipeline

The researchers have created a new pipeline, which is a series of steps, to make customized cell culture devices using 3D printing. This method is designed to be accessible even to labs without extensive engineering resources or experience.

Key Features:

1. **High-Resolution**: It allows to produce cell- and subcellular scale features
2. **Versatile**: It allows for the creation of devices with complex designs tailored to specific experimental needs.
3. **Reproducible**: The process can be consistently repeated to produce identical devices, ensuring reliable experimental results.
4. **Cost-Effective & Easy to implement**: The new method uses inexpensive materials and equipment, but more importantly does not require prior knowledge in engineering or microfabrication

Materials and Methods

The primary material used is polydimethylsiloxane (PDMS), a silicone-based substance that is biocompatible (safe for cells) and transparent, allowing easy observation of cells. The method involves using 3D-printed molds to shape PDMS into custom devices. This approach combines modern 3D printing technology with traditional cell culture techniques, offering the best of both worlds.

Benefits for Biomedical Research

1. **Improved Control**: Researchers can precisely control the positioning, grouping, and interactions of cells within the device.
2. **Customization**: Devices can be tailored to the specific needs of different experiments, allowing for more detailed and relevant biological studies.
3. **Accessibility**: The low cost and ease of use make this technology accessible to a wide range of laboratories, potentially accelerating scientific discoveries.

Applications

This innovative approach can be used in various fields of biomedical research, including:

- **Disease Modeling**: Creating accurate models of diseases using patient-derived cells to study disease mechanisms and test potential treatments.
- **Drug Testing**: Evaluating the effects of new drugs on cells in a controlled environment.
- **Tissue Engineering**: Developing new tissues for transplantation by growing cells in 3D structures that mimic natural tissues.

Conclusion

Developing this accessible, high resolution, versatile, and reproducible microfabrication pipeline represents a significant advancement in cell culture. By enabling researchers to create customised and precise cell culture environments, this technology holds great promise for enhancing the accuracy and relevance of biomedical research, ultimately leading to better understanding and treatment of diseases.

For more detailed information, you can refer to the full research article published in PLOS Biology: Low-cost, versatile, and highly reproducible microfabrication pipeline to generate 3D-printed customised cell culture devices with complex designs.