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Tissue Microenvironment Microfluidic Devices

Recent advances in manufacturing techniques have enabled the development of platforms and devices to study tissues and cells within well defined 3D microenvironments. Current devices have many limitations, however, because they are primarily made with polydimethylsiloxane (PDMS). PDMS is soft, so it is difficult to create reliable fluid connections through ports, and the scaffold regions of PDMS devices make it difficult to control air ingress and/or humidity. Further, PDMS has been found to have drug absorption properties which reduce its utility in drug screening or development applications. As such, there exists a need for optimized microfluidic devices that address the limitations of current devices on the market.

Researchers at Arizona State University have developed optimized microfluidic devices with scalable manufacturing processes which don't utilize PDMS. These devices are optimized for biocompatibility and sterility as well as to have optical transparency or translucency for viewing with a microscope. They can further be optimized to have reduced drug absorption, gas permeability, humidity control and pipetting for cell culture as well as modularity for microfluidic well-plate systems.

Because these novel microfluidic devices are so optimized, they can be used for drug development, drug screening, organ-on-chip, biotechnology, microfluidic, tissue and many more applications.

Potential Applications

- Microfluidic devices
  - Drug screening, discovery & development
  - Organ-on-chip technologies
  - Creating cell and tissue microenvironments
  - Biotechnology

Benefits and Advantages

- Can have optical transparency or translucency
- Optimized for scaled mass manufacturing techniques such as injection molding, casting, 3D printed, hot embossed, etc.
- Gas permeability for cell culture with leakage prevention
- Amenable to drug screening and development applications because of limited or no drug absorption attributes
- Modular within the microfluidic well-plate system and regulates humidity
- Biocompatible and sterile materials
- Optimized for pipetting into the device
- Compatible with common sterilization techniques including ethylene oxide, autoclave, gamma radiation and electron irradiation
- Can be treated to modify cell attachment, adhesion and growth

For more information about the inventor(s) and their research, please see

Dr. Nikkhah's departmental webpage

Dr. Nikkhah’s laboratory webpage