Droplet microvortices for modulating cell dynamics

Tech ID: 33468 / UC Case 2022-99H-0

BRIEF DESCRIPTION

The invention presents a microfluidic platform equipped with specialized trapping arrays and droplet generation capabilities, enabling precise control over the formation of microvortices within cell-laden droplets. This novel system facilitates the study of cell-cell interactions at a single-cell level, offering configurable microenvironments for analyzing cell dynamics and pair relationships.

SUGGESTED USES

The microfluidic platform described in the invention has several potential uses:

- **Cell-Cell Interaction Studies:** It enables detailed analysis of cell-cell interactions at a single-cell level, providing insights into various biological processes such as genetics, oncology, and immunology.
- **High-Throughput Analysis:** The platform allows for high-throughput screening of cell dynamics and interactions, enhancing the efficiency of experiments compared to conventional methods.
- **Immunometabolic Function Assessment:** It can be employed for real-time assessment of immunometabolic functions, particularly through glycolytic state determination via NADH autofluorescence.
- **Biomechanical Studies:** The system facilitates the examination of cell morphology and surface markers within isolated compartments, aiding biomechanical studies of cell behavior.
- **Drug Development and Screening:** It may find applications in drug development and screening processes, particularly in understanding cellular responses to drugs and therapeutic agents.

Overall, the microfluidic platform offers a versatile tool for researchers to study cell behavior, interactions, and responses in controlled microenvironments, with potential implications for various fields including biology, medicine, and pharmaceuticals.

FEATURES/BENEFITS

The microfluidic platform described in the invention offers several features and benefits:

- **Precise Control Over Microvortices:** The platform enables precise control over the formation and characteristics of microvortices within cell-laden droplets, providing a tailored microenvironment for studying cell dynamics and interactions.
- **Single-Cell Analysis:** It facilitates high-resolution analysis of cell-cell interactions at the single-cell level, allowing researchers to examine specific interactions without interference from background or neighboring cells.
- **High Throughput:** The system supports high-throughput screening of cell behavior and interactions, enhancing the efficiency of experiments compared to traditional methods.

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OTHER INFORMATION

KEYWORDS

Microfluidic platform, Cell-cell interactions, Single-cell analysis, Microvortices, Droplet generation, Trapping arrays, High-throughput screening, Cell dynamics, Biomechanical studies, Immunometabolic function

CATEGORIZED AS

- **Biotechnology**
  - Other
- **Medical**
  - Other
  - Research Tools
  - Screening
- **Research Tools**
  - Cell Lines

» **Real-Time Assessment:** Researchers can perform real-time assessment of immunometabolic function and other cellular responses within isolated compartments, providing dynamic insights into cellular processes.

» **Biomechanical Studies:** The platform enables examination of cell morphology and surface markers within droplets, facilitating biomechanical studies and understanding cell behavior in response to mechanical stimuli.

» **Versatility:** It offers versatility in experimental design, allowing researchers to configure microvortices and control cell pairing positions and interaction frequencies according to the specific requirements of their study.

» **Innovation in Trap Design:** The specialized trapping arrays and droplet configurations contribute to the unique ability to induce microvortices without the need for external materials or components.

» **Improved Understanding:** By providing a controlled environment for studying cell-cell interactions, the platform enhances the understanding of complex biological processes such as genetics, oncology, and immunology.

Overall, the microfluidic platform offers researchers a powerful tool for advancing the understanding of cellular behavior, interactions, and responses, with potential applications in various fields including biology, medicine, and drug development.

» Other

» Screening Assays

RELATED CASES

2022-99H-0

FULL DESCRIPTION

The microfluidic platform operates by utilizing specialized trapping arrays and droplet generation to create well-defined microvortices within cell-laden droplets. Here's how it works:

Droplet Generation: The process begins with the droplet generator, which accepts cells and generates cell-laden droplets. Each droplet contains cells surrounded by an aqueous solution, which in turn is surrounded by a carrier oil.

Fluidic Chamber and Trapping Arrays: The generated droplets are directed from the droplet generator into a fluidic chamber. This chamber contains one or more trapping arrays, each consisting of pillars separated by gaps. As the droplets flow through the chamber, they encounter these trapping arrays.

Immobilization of Droplets: The trapping arrays serve to immobilize the droplets within the fluidic chamber. The design of the arrays ensures that the droplets are held in place while still allowing the carrier oil to flow continuously through the chamber.

Induction of Microvortices: As the carrier oil flows past the immobilized droplets and through the gaps in the trapping arrays, it induces microvortices within the droplets. This is achieved through shear stress at the liquid-liquid interface between the aqueous solution and the carrier oil.

Controlled Cell Dynamics: The induced microvortices create a controlled microenvironment within each droplet, influencing the dynamics of the cells encapsulated within. Researchers can adjust parameters such as microvortex shape, periodicity, and recirculation time to study specific cell behaviors and interactions.

Analysis and Observation: Researchers can observe and analyze the behavior of cells within the droplets using microscopy or other analytical techniques. The platform provides a controlled environment for studying cell-cell interactions at a single-cell level, facilitating various biological and biomedical applications.

In summary, the microfluidic platform combines droplet generation, trapping arrays, and continuous carrier oil flow to create well-defined microvortices within cell-laden droplets. This enables precise control and analysis of cell dynamics and interactions, offering insights into complex biological processes.

STATE OF DEVELOPMENT

Prototype developed

PATENT STATUS

Patent Pending

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