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A Mother-machine Microfluidic Device for Leukemia Cell

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We develop a mother machine-like microfluidic device designed to track the proliferation of single mammalian cells via live-cell microscopy.

Although numerous microfluidic devices have been developed to study cell proliferation at the single-cell level, most are optimized for bacteria.

We present a device specifically designed to track the proliferation of human primary T cells, featuring microchannels that trap cells without altering their physiological conditions.

Each microchannel allows a single cell to enter, proliferate, and receive a continuous nutrient flow, ensuring long-term monitoring over multiple generations. The channel geometry, optimized via computational fluid dynamics, maintains stable trapping conditions and cell viability.

Here we show the system's advantages in studying cell growth and division.

Timelapse microscopy enables tracking of individual cells, measuring key parameters like cell size and duplication time.

First, we test the device by reproducing previous results on symmetric volume division in Jurkat T cells.

Then, we use it to follow the growth and division of T cells at single cell level by measuring:(i) duplication time;(ii) cell size dynamics, from birth to mitosis;(iii) shear stress effects on growth by varying channel inclination.

Overall, our adaptable device supports different cell types and sizes while maintaining high trapping efficiency.