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Chips and Fabrication Methods for Rotation of Live Single Cells or Cell Clusters in Live Cell Computed Tomography

High-dimensional single cell visualization technologies are redefining the way we view and understand biological systems, particularly when identifying and analyzing cancer cells. Some cell defects on the surface or in the interior of a cell just can't be properly evaluated in two dimensional microscopy. However, to completely visualize and quantitatively image single cells or cell clusters, the cell/cells needs to be rotated while maintaining them in the field of view of an optical microscope.

Researchers at Arizona State University have developed novel photolithographic fabrication methods and systems for hydrodynamic microvortical rotation of microparticles, live single cells or cell clusters. The use of unique 3D microchamber designs and optical trapping system produces optimal conditions in the microfluidic chip to enable rotation of the single cells or cell clusters, enabling visualization of the entire surface of the cell. Moreover, this can be done in bright-field or fluorescence mode microscopy and may also be used for 3-D tomographic imaging, to allow high resolution volumetric images.

Rotation of the cells about an arbitrary axis, perpendicular to the optical axis in a stable and controlled fashion allows for undistorted image acquisition and visualization of the entire cell.

Potential Applications

- Visualization of the entire surface of a microparticle, single cell or cell cluster
  - Cancer cell identification and analysis
  - Studying disease progression, development, treatment and prognosis
  - Investigating disease models
  - mRNA/cell stress analyses

Benefits and Advantages

- Cells/clusters/microparticles can be oriented in real-time for dynamic adjustment and realignment with respect to the imaging plane
- Able to produce constant low particle velocities and bring the particle to zero velocity in less than a second
- Provides interference-free imaging on a plane parallel to the axis of rotation
- Inexpensive fabrication and assembly - utilizes variations to conventional microfluidic fabrication

For more information about the inventor(s) and their research, please see Dr. Meldrum's directory webpageDr. Meldrum's Biodesign directory webpage