Group #21

Millifludic Device for Brain Organoid Sorting

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Abstract

Brain organoids are 3D stem cell-derived tissue models used in neuroscience research that exhibit significant morphological variability within batches, yet current sorting methods rely on manual pipetting which is time-consuming, subjective, and risks organoid damage. We designed and fabricated a semi-automated millifluidic sorting platform integrating real-time imaging and a machine learning classification algorithm with servo-actuated pinch valve sorting to classify and redirect organoids into pass/fail outlets based on size and sphericity as they flow through channels in a millifluidic chip. The chip was made using PDMS cast onto a resin printed mold and bonded to a glass substrate, and flow conditions were validated to maintain wall shear stress below the viability threshold across operating flow rates ($Q = 60$ μL/s). Subsystem validation using bead phantoms confirmed stable organoid transport, consistent hydrodynamic focusing via mineral oil sheath flow, and accurate classification decisions from real-time images, with full system integration accuracy and live organoid viability testing planned as next steps. This platform establishes a foundation for standardized, accessible organoid sorting with future development targeting advanced morphological classification and multi-class sorting.