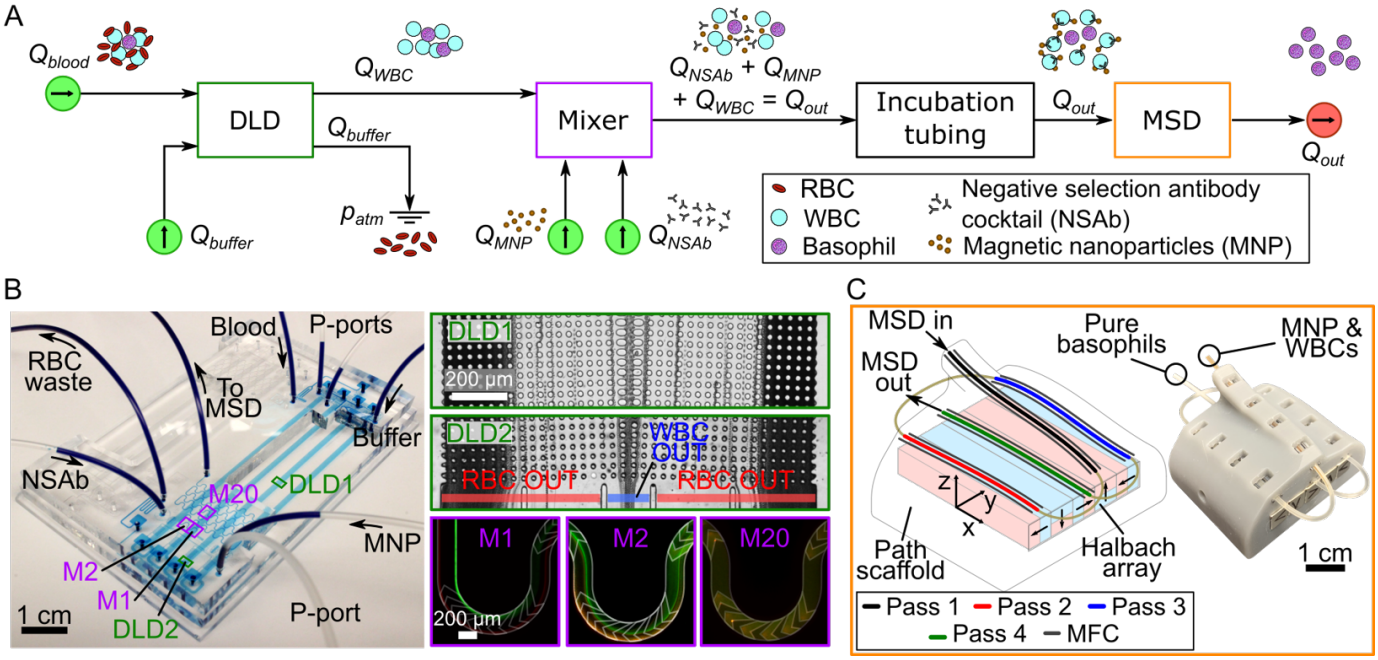
Docket #: S21-328

Microfluidic Magnetic Separation Device for Isolation of a Target Cell from Whole Blood

Researchers at Stanford have developed a magnetophoretic separation device (MSD) for isolating basophils and other rare cell types from a blood sample. The device applies exponentially increasing magnetic field strength to flowing magnetically tagged cells. Immunomagnetic negative selection of target cells is used to maintain target cells in their native, unlabeled state. The device is suitable for isolating cells from low volumes of whole blood, which provides an advantage over in-bulk methods that require larger starting volumes of blood. While microfluidics has emerged as a promising technology for the precise separation and isolation of cells, current methods lack a streamlined approach for applying magnetophoretic forces that are compatible with downstream microfluidic process flows. Existing on-chip magnetic-activated cell sorting (MACS) methods generally require the integration of multiple inlets/outlets and require a precise alignment with off-chip magnets, otherwise the isolation purity is compromised. The new device does not require careful alignment and is reusable, with its only consumable being tubing through which the cell suspension flows.



Overview of the basophil isolation device (iBID) process flow (*image credit: the inventors*)

Stage of Development

The researchers have found that their MSD allows for the isolation of basophils from 100 uL volumes of blood with consistently high purity (>90%) and recovery (>90%). This is in contrast to commercial kits using magnetic columns that are incompatible with processing such small starting volumes of blood and are unable to achieve such consistently high purity and recovery.

Applications

- Commercial and research applications requiring purified leukocyte subtypes (e.g., neutrophils, eosinophils, monocytes)
- Faster single-cell RNA-sequencing – an emerging microfluidics technology that requires purified sub-populations of the cell of interest
- Isolation of basophils to support on-chip basophil activation testing for food allergy diagnosis
- Isolation from whole blood is compatible with ex vivo stimulation in immune functional assays
- Compatible with downstream microfluidics workflows

Advantages

- High purity and recovery (>90%) of target cells
- Faster MSD-enhanced isolation methods can improve cell viability and avoid potential changes to the cell phenotype that could occur throughout the course of an in-bulk isolation process
- Robust and reusable
- Adaptable to a variety of form factors and easily parallelizable
- Cells isolated from whole blood without washing steps or prior red blood cell depletion

Publications

- Exponential magnetophoretic gradient for the direct isolation of basophils from whole blood in a microfluidic system. Castaño et al., bioRxiv

Patents

- Published Application: WO2023044161
- Published Application: 20240393323

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