

Separation of cancer cells in a zig-zag microchannels

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Abstract.

When blood flows through a tiny channel, cells naturally drift side to side. Shaping the channel in a zig zag pattern amplifies this drift so that cells of different sizes and shapes follow distinct paths without labels or external forces. We used computational fluid dynamics (CFD) simulations in a microchannel made of five contiguous diamond shapes each 160 μ m wide with 60° internal angles to study how size and shape influence focusing and separation of cell analogues. We seeded twenty solid spheres, ten of 5 μ m diameter and ten of 10 μ m diameter, and then tested doublets formed by joining two small or two large spheres. Simulations ran at four flow speeds of 0.18, 0.35, 0.45 and 0.60 m/s. Over sixty passes we recorded particle crossings at a fixed line. Higher flow speeds produced faster and clearer separation: single spheres formed two side bands while doublets formed three bands. Optimal separation occurred at flow speeds between 0.45 and 0.60 m/s, and this balance of speed, resolution, and gentle shear makes the design well suited for isolating rare cells - such as circulating tumour cells - from whole blood while preserving cell viability.

Keywords. microfluidics, zig-zag channel, cell separation, fluid dynamics, particle focusing, label-free method, high-throughput sorting, cancer cells

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References

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