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Size-dependent cell separation and enrichment using double spiral microchannels GUOQING HU, CHAO LIU, LNM, Institute of Mechanics, Chinese Academy of Sciences, JIASHU SUN, XINGYU JIANG, National Center for NanoScience and Technology, Beijing — Much attention has been directed toward microfluidic technologies that can help improve circulating tumor cells (CTCs) separation from the blood sample. In the present work, we develop a double spiral microfluidic platform with one inlet and three outlets that allows for passive, label-free tumor cell enrichment with high throughput and efficiency, inspired by the single spiral cell sorter. The curved channel induces a Dean drag force acting on cells to compete with the inertial lift, resulting in large tumor cells to be focused and deflected into the middle outlet while small hematologic cells are removed from the inner outlet. We continuously isolated and enriched the rare tumor cells (MCF-7 and Hela cells) from diluted whole blood using the same geometry. At a spike ratio of 100 tumor cells per million hematologic cells, 92.28% of blood cells and 96.77% of tumor cells were collected at the inner and middle outlet, respectively, at the throughput of 33.3 million cells per minute. A numerical model is developed to simulate the Dean flows inside the curved geometry and to track the particle/cell trajectories, which is validated against the experimental observations and serves as a theoretical foundation in optimizing the operating conditions.

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