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High-Throughput On-Chip Diagnostic System for Circulating Tumor Cells JAEHOON CHUNG, HUILIN SHAO, RALPH WEISSLEDER, HAKHO LEE, Center for Systems Biology, Massachusetts General Hospital — We have developed a novel, low-cost and high-throughput microfluidic device for detection and molecular analysis of circulating tumor cells (CTCs). The operation is based upon a size-selective cell separation, which was enabled by a weir-style physical barrier with a gap in the fluidic channel. The new system is a versatile CTC analysis platform with many advantages. First, it supports extremely high throughput operation, since the use of weir structure reduces fluidic resistance and enables flow-through separation ($>$ 20,000-fold CTC enrichment from whole blood at the flow rate of 10 mL/h). Second, the CTC-chip facilitates visual verification and enumeration of CTCs during/after operation. By implementing microwell-shaped structures on the physical barrier, CTCs can be individually captured at sites for single-cell resolution analyses. Furthermore, the captured cells could be profiled in situ by introducing antibodies or small molecular probes. The chip thus assumes not only high detection sensitivity but also molecular specificity for CTC identification. Finally, the CTC-chip can retrieve captured CTCs. By reversing the flow direction, the cells can be dislodged from their capture sites and collected for downstream investigation.

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