

Supplementary Information for

**SSA-MOA: A Novel CTC Isolation Platform Using Selective Size
Amplification (SSA) and a Multi-Obstacle Architecture (MOA) Filter**

Minseok S. Kim¹, Tae Seok Sim¹, Yeon Jeong Kim¹, Sun Soo Kim², Hyoyoung Jeong¹, Jong-Myeon Park^{1,3}, Hui-Sung Moon¹, Seung Il Kim⁴, Ogan Gurel⁵, Soo Suk Lee^{*1}, Jeong-Gun Lee^{*1}, and Jae Chan Park¹

¹ POCT In Vitro Diagnostics Group, Bio Research Center, Samsung Advanced Institute of Technology (SAIT), Samsung Electronics Co., Ltd., San 14, Nongseo-dong, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea.

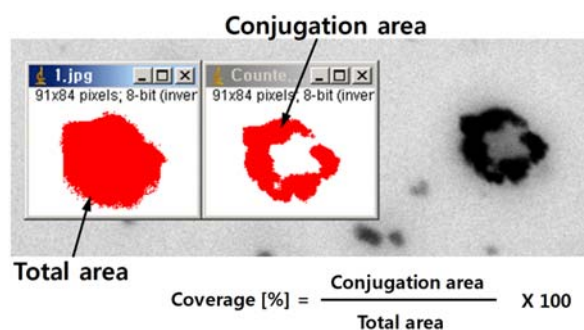
² R&D Solution group, Samsung Advanced Institute of Technology (SAIT), Samsung Electronics Co., Ltd., San 14, Nongseo-dong, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea.

³ Department of Chemistry and Center for Bioactive Molecular Hybrids, Yonsei University, Seoul 120-749, Republic of Korea.

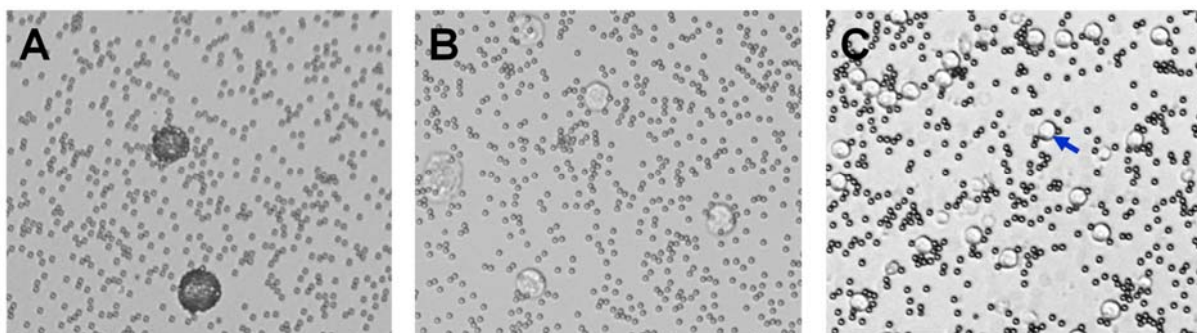
⁴ Department of Surgery, Yonsei University College of Medicine, 134 Shinchon-dong, Seodaemun-gu, Seoul, Republic of Korea.

⁵ CTO Office – MOT Research Center, Samsung Advanced Institute of Technology (SAIT), Samsung Electronics Co., Ltd., San 14, Nongseo-dong, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea.

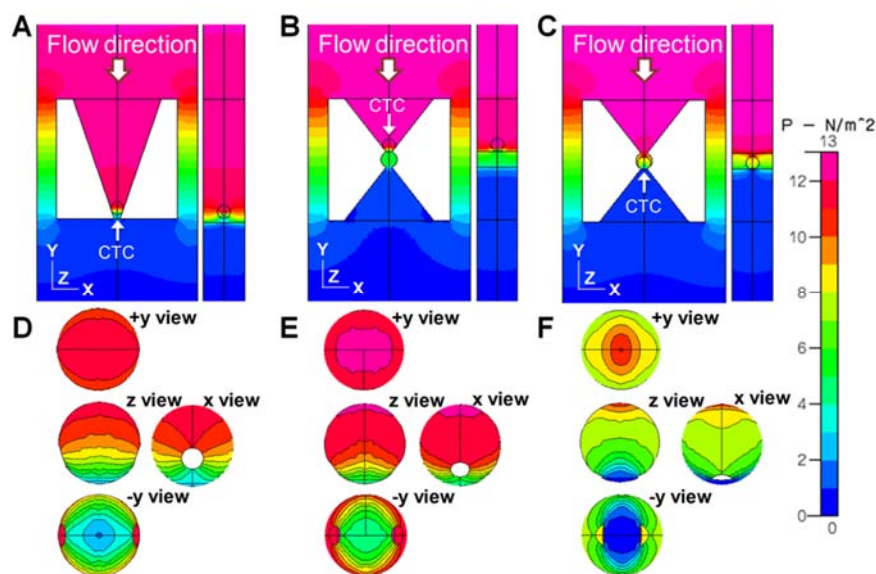
* Correspondence should be addressed to S. S. Lee (soosuk@samsung.com) and J.-G. Lee.
(biogun.lee@samsung.com).



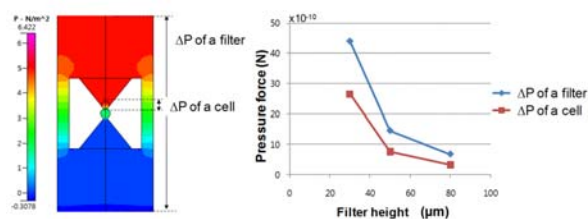
Supplementary Fig. 1. Image analysis of cell surface microbead coverage. Coverage was defined by the percentage ratio of the area occupied by beads (conjugation area) to the total area.



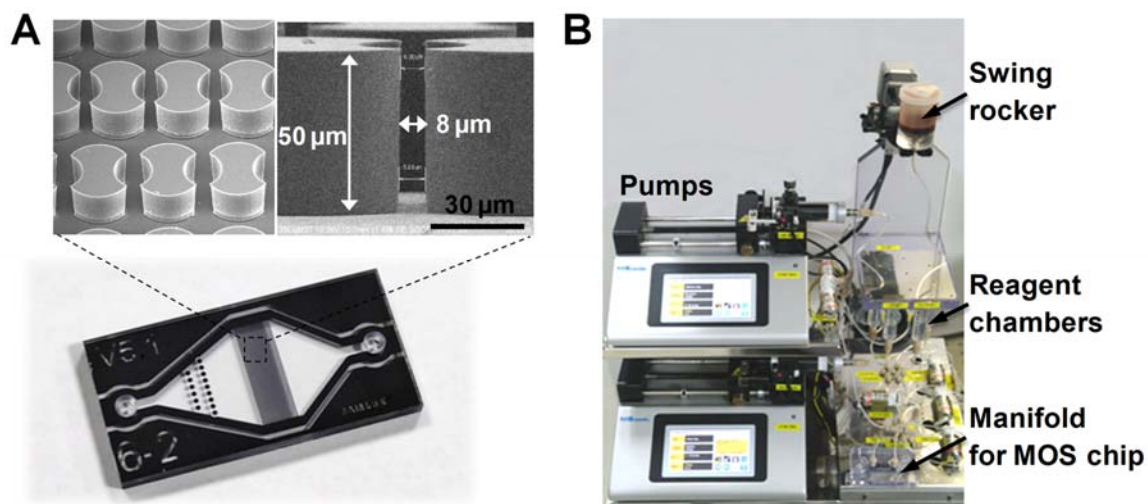
Supplementary Fig. 2. Optical microscopic verification of the selectivity of size amplification (e.g. the adherence of microbeads to CTCs and not to WBCs). In these images (100 × magnification), 3 μm microbeads were used. Three images are shown: (A) MCF-7 cells clearly adhering to the microbeads and thus size-amplified, (B) MDA-MB-231 cells showing no interaction with the microbeads, (C) human leukocytes (for example, as denoted by the blue arrow) are shown in the presence of microbeads but clearly not adhering.



Supplementary Fig. 3. Simulation results for the cell surface pressure distribution (PD) for a single-obstacle filter and the MOA filter. The stress scale (in $\text{N}\cdot\text{m}^{-2}$) is given with the color bar on the right. **(A and D)** PD of captured cell in a single-obstacle filter. **(B and E)** PD within the first MOA filter gap. **(C and F)** PD within the second MOA filter gap. When a cell was positioned within the second MOA filter gap, the stress applied to the cell was significantly reduced.



Supplementary Fig. 4. Pressure forces experienced by cells as a function of filter height. The pressure force dropped significantly at a filter height between $30\ \mu\text{m}$ and $50\ \mu\text{m}$.



Supplementary Fig. 5. MOA microfilter chip and automated workstation for CTC separation.

(A) MOA microfilter fabricated by SOG technology. (B) For automated fluidic control, two pumps were used for the two modes, infuse (chip priming, bubble removal) and withdrawal modes (reagent/sample injection).