## **Electronic Supplementary Information (ESI)**

## A scalable stirring system using suspended magnetically-actuated pillars for controlled cell clustering

Aref Saberi<sup>a†</sup>, Shuaizhong Zhang<sup>bc†</sup>, Carola van den Bersselaar<sup>a</sup>, Harkamaljot Kandail<sup>a</sup>, Jaap M.J. den Toonder<sup>bc</sup>, and Nicholas A. Kurniawan<sup>\*ac</sup>

<sup>a</sup>Department of Biomedical Engineering, <sup>b</sup>Department of Mechanical Engineering, <sup>c</sup>Institute for Complex Molecular Systems, Eindhoven University of Technology, Eindhoven, The Netherlands.

+ These authors contributed equally.

\* To whom correspondence should be addressed: N.A. Kurniawan (kurniawan@tue.nl).

## Supplementary figures



**Figure S1.** Snapshots from a typical stirring experiment, where the SMAP was actuated with a motor rotation of 300 rpm. The black dots are the 30  $\mu$ m polylactic acid particles. The colored dots and lines indicate the progessive trajectories of several tracer particles approximately in the same height level as the tip of the pillar, as tracked using the Manual Tracking function in ImageJ. The magnetic pillar used here is the aSMAP with a diameter of 1 mm and height of 7 mm. Scale bar = 1 mm and the time interval is indicated.



**Figure S2.** Stirring-induced clustering of cells at the edge of the well at different stirring speeds. Scale bar =  $500 \mu m$ .



**Figure S3.** Result of control cell-stirring experiment at 0 rpm stirring speed, showing the absence of any cell clustering. Scale bar =  $500 \mu m$ .



**Figure S4.** Fluid flow velocity profiles during stirring using a 7 mm rigid rod. The pillar is actuated with angular rotations of 150, 200, 250, and 300 rpm. (A) The resulting flow profile at different heights: 0.2, 2, 4, and 6 mm from the bottom of the well. (B) The vertical cross-sectional flow profile at the middle of the well. (C) The distributions of the flow directions, as shown by the arrows. The colors correspond to the magnitude of the flow velocity as indicated in the color bar.