

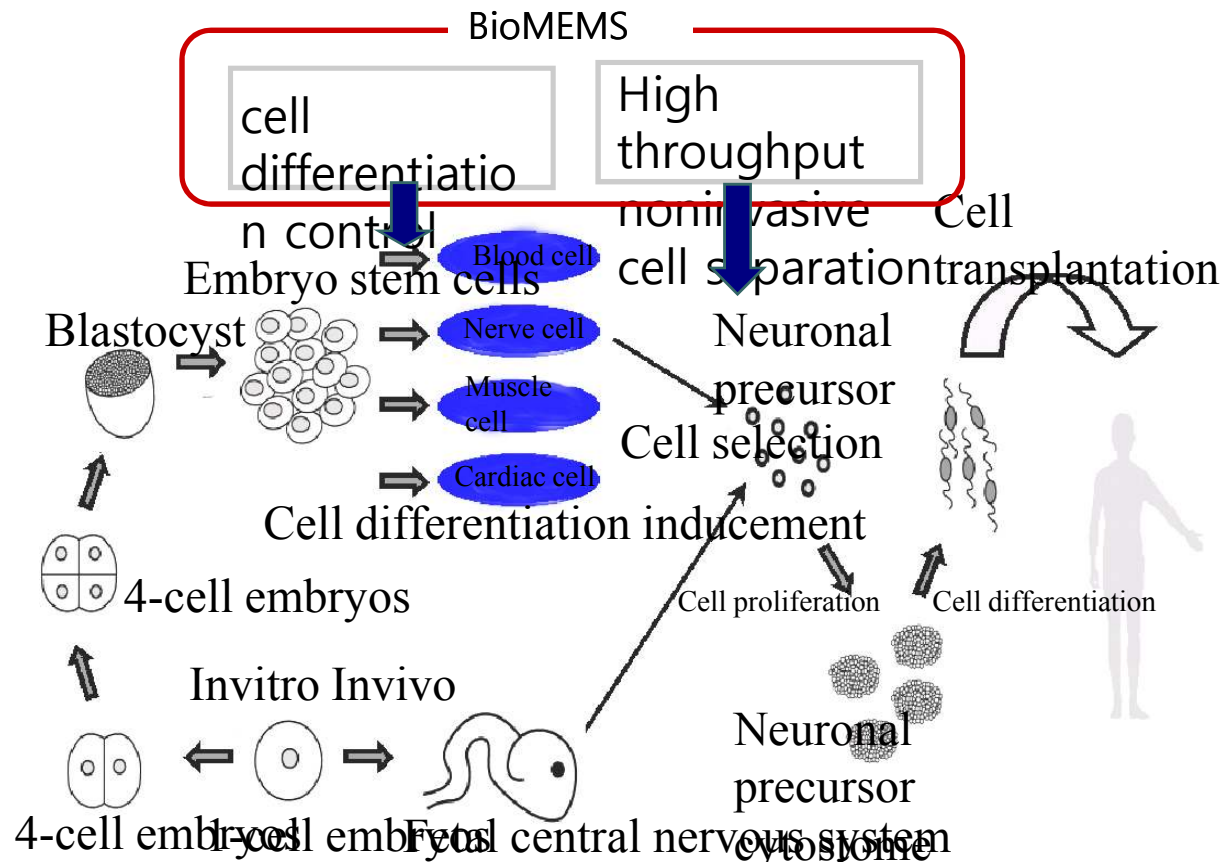
연구분야 3. 유전영동을 이용한 세포의 물리적 특성분석 및 미소분리 시스템 개발

유전영동을 이용한 세포분리 기술 개발

Cell Sampling and Separation

Issues

- molecular biology, drug screening, diagnostics, and cell replacement therapy
- 90% of the cost and 95% of the time are spent to prepare cell sampling.
- Stem cell purification is essential to be use for CRT

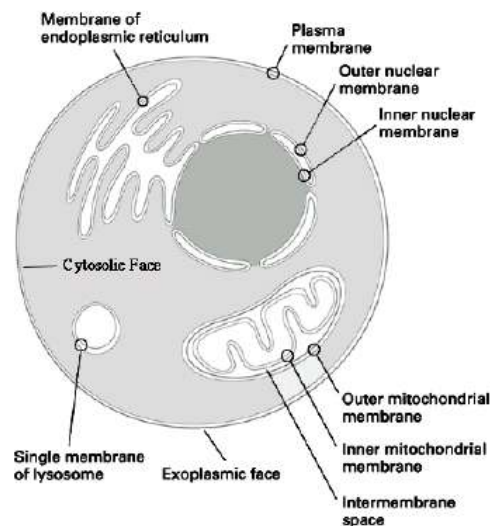


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유전영동을 이용한 세포분리 기술 개발

- Advantages of AC electrokinetics [Y. Huang et al., 2002]
 - *Controllability*
 - *Ease of application to automation*
 - *Noninvasive (No biochemical labels, probes or tag required)*
 - *Diverse Applications*
- Cell and AC electrokinetics [Aura BioSystems, 2003]

Electronic “CR” Time-Constant of the Cell



- Capacitance “C”:
(Charge stored at membrane interfaces)
 - Cell size and shape
 - Membrane morphology
 - Membrane surface charge
 - Nucleus/Cytoplasm volume ratio
- Resistance “R”:
(Ionic conduction in cytoplasm, across or over membrane surfaces)
 - Membrane integrity
 - Membrane surface charge
 - Ion channels

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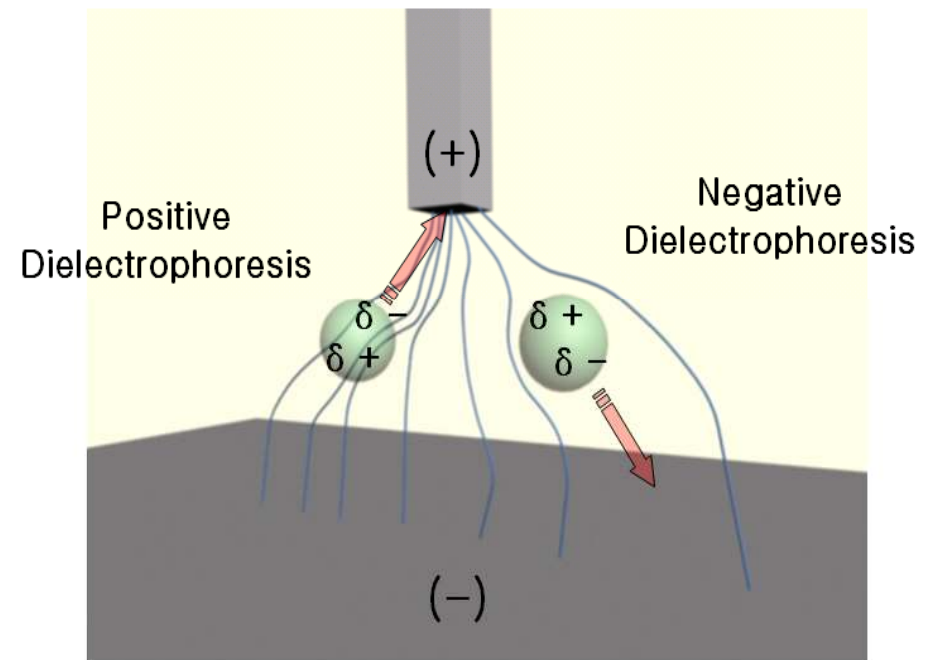
유전영동을 이용한 세포분리 기술 개발

- Dielectrophoresis was termed by Pohl(1978)
 - Known as AC electrokinetics
- Kinds of AC electrokinetics
 - Positive DEP
 - Negative DEP
 - *Traveling wave DEP*
 - *Electrorotation*
- Dielectrophoretic force

$$F_{DEP} = 2\pi\epsilon_m r^3 \text{Re}(f_{CM}) \nabla |E_{rms}|^2$$

- Clausius-Mossotti factor

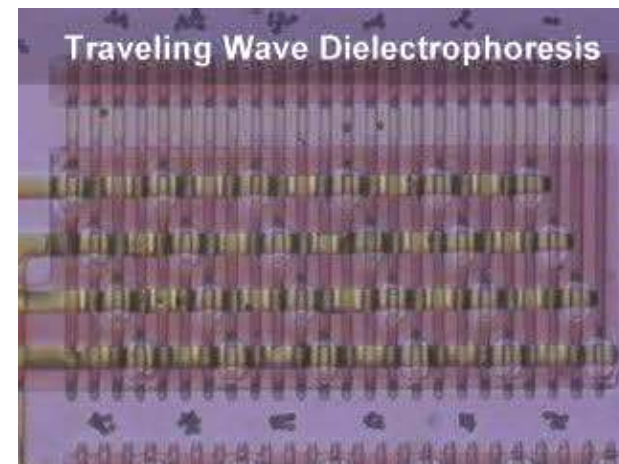
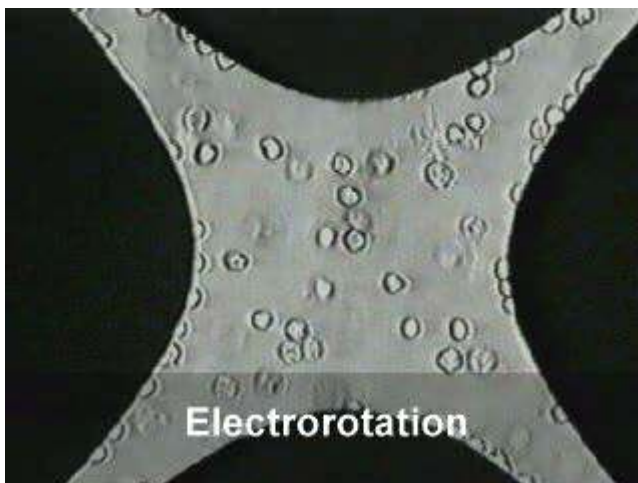
$$f_{CM} = \frac{\epsilon_p^* - \epsilon_m^*}{\epsilon_p^* + 2\epsilon_m^*}$$



Different motion of two particle in non-uniform electric field.

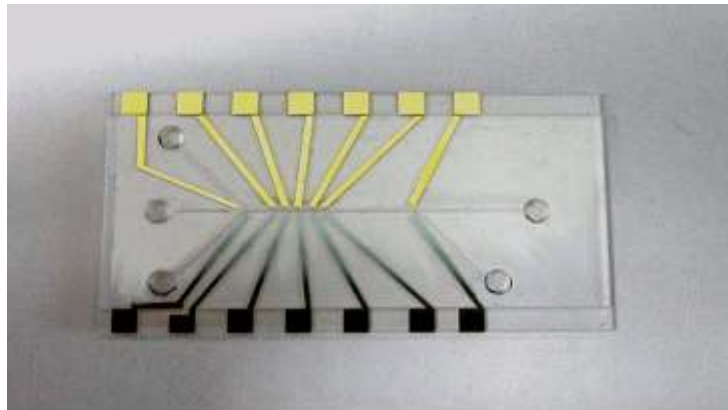
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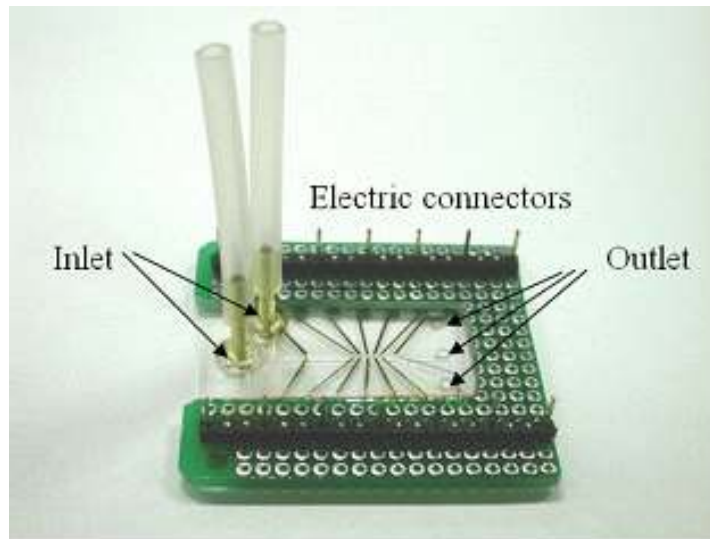


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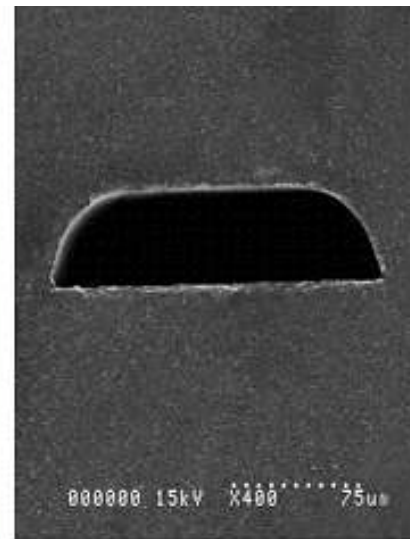
유전영동을 이용한 세포분리 기술 개발



A photograph of completely fabricated device.



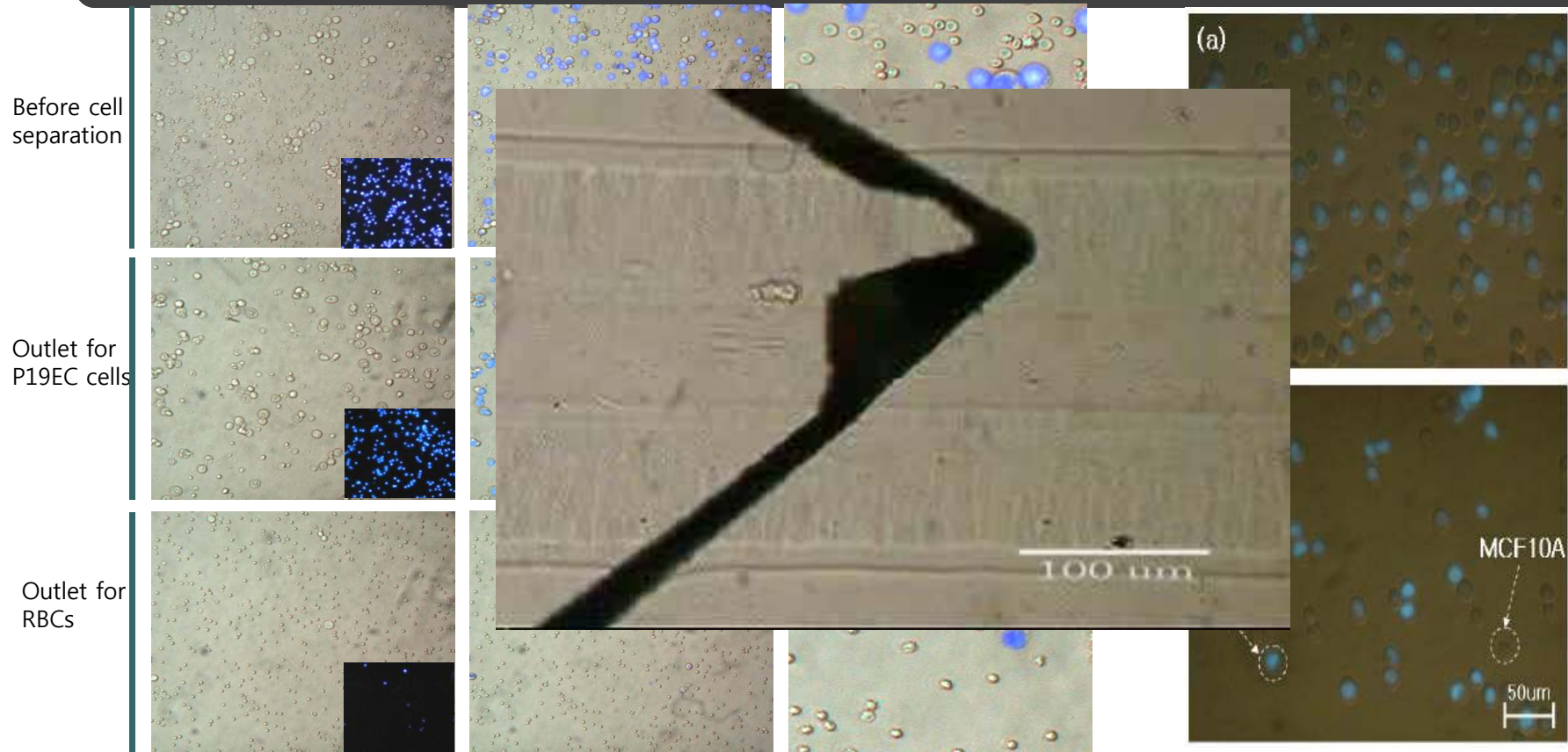
A photograph of Packaging assembly.



A SEM image of microchannel.

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유전영동을 이용한 세포분리 기술 개발



- Cells were counted under indirect immuno-fluorescence after being counterstained with Hoechst 33528
- Purity of cells is proved with $94.05 \pm 4.3\%$ for RBC and $81.53 \pm 7.61\%$ for P19EC cell, respectively
- we obtain $77 \pm 5\%$ purity of MCF7 cells in the outlet for MCF7 cells.

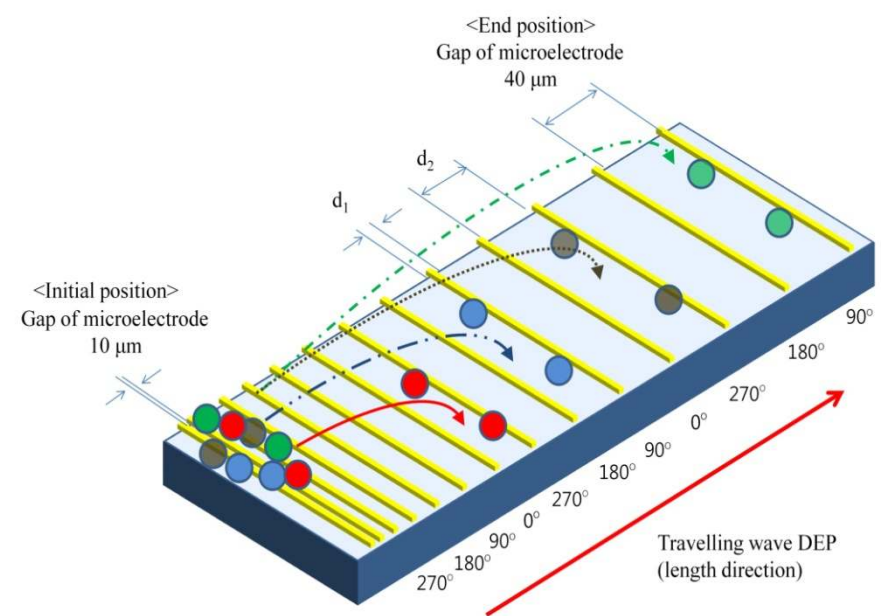
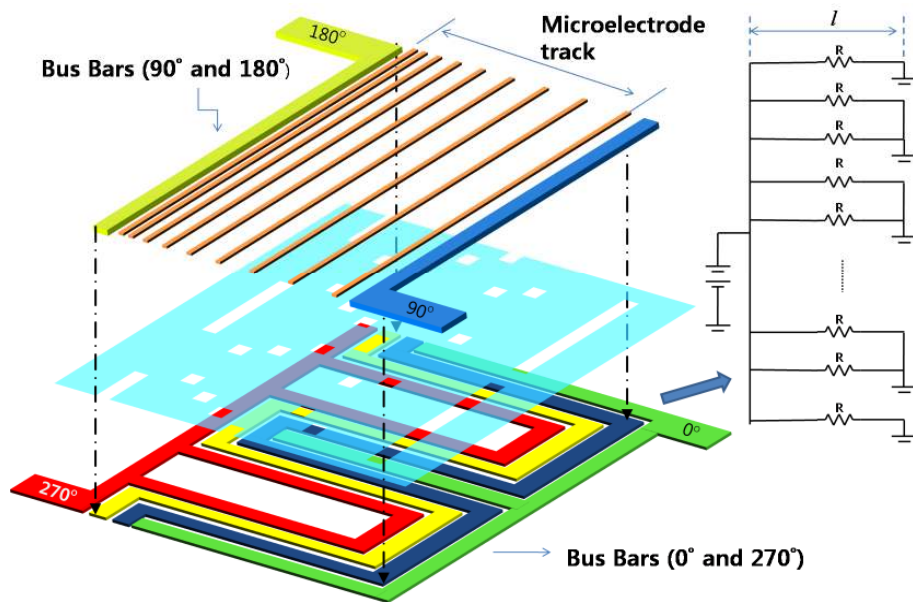
J. Park et al., Lab on a chip, 2005

J. An et al., IEEE Sensors, 2006

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Proposed Design



- Four input signals are divided into two groups (one is for 0° and 270° and the other is for 90° and 180°)
- These two groups are formed in the different layers .

Gradually increased gaps between electrodes. TwDEP force was decreased gradually along the microelectrode track, and finally particles can be trapped at the specific locations according to their physical properties

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