Mixing and Heating Using Magnetic Nanoparticles

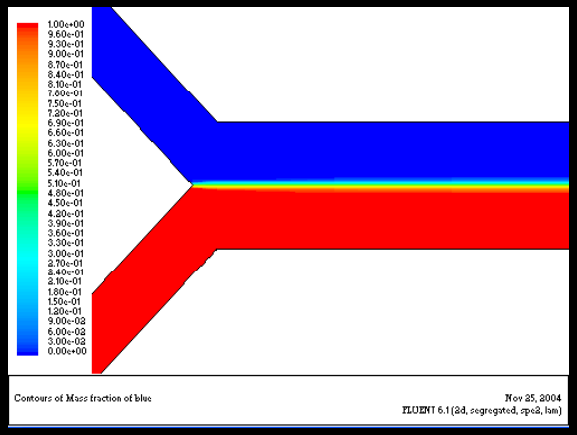
미세 흐름의 특성

- 낮은 레이놀즈 수(Low Reynolds number)

$$Re = \frac{D v \rho}{\mu}$$

D = hydraulic diameter of the channel
v = flow rate
ρ = density of the fluid
μ = viscosity of the fluid

in microchannels, small D & small v → very small Re (<100) !!



미세유체 혼합의 필요성

Passive Mixing

- **Geometrically splitting and recombining substreams**

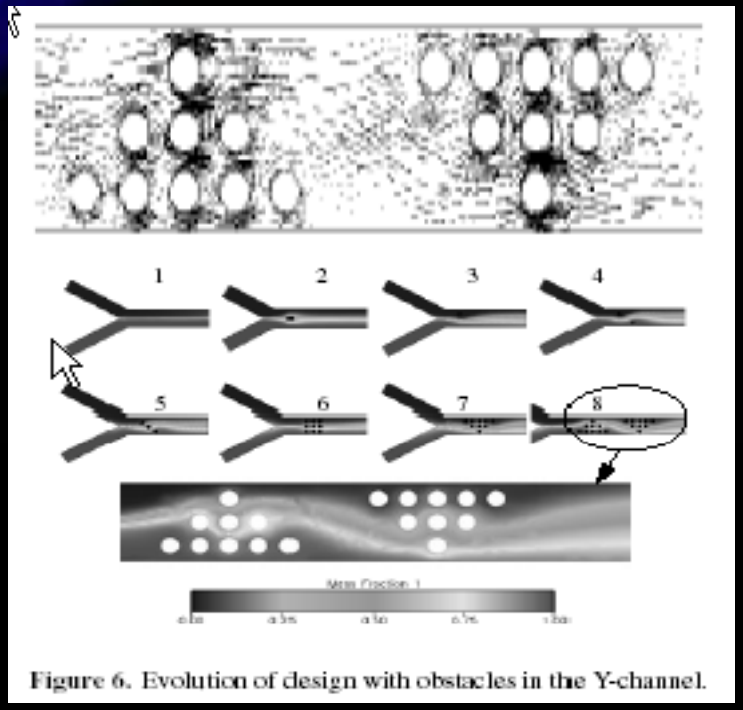
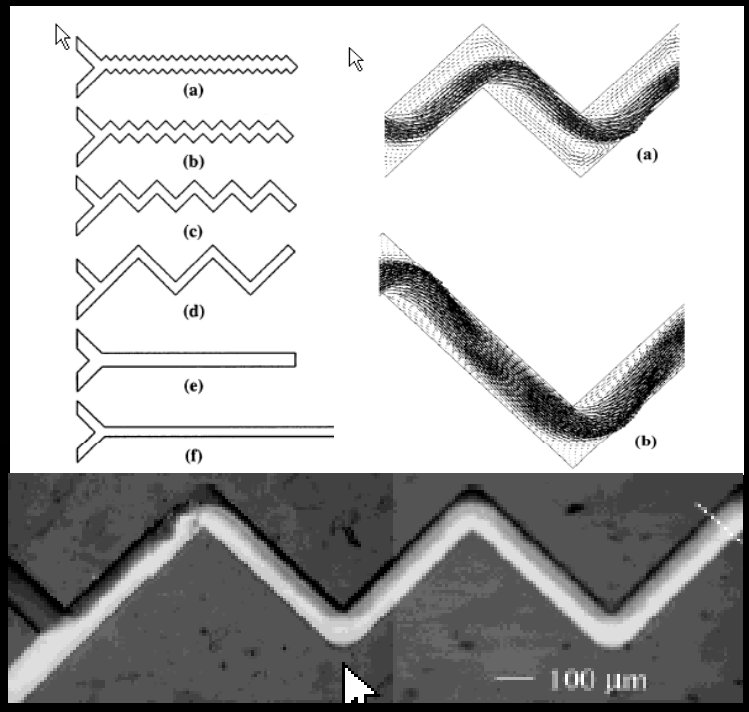


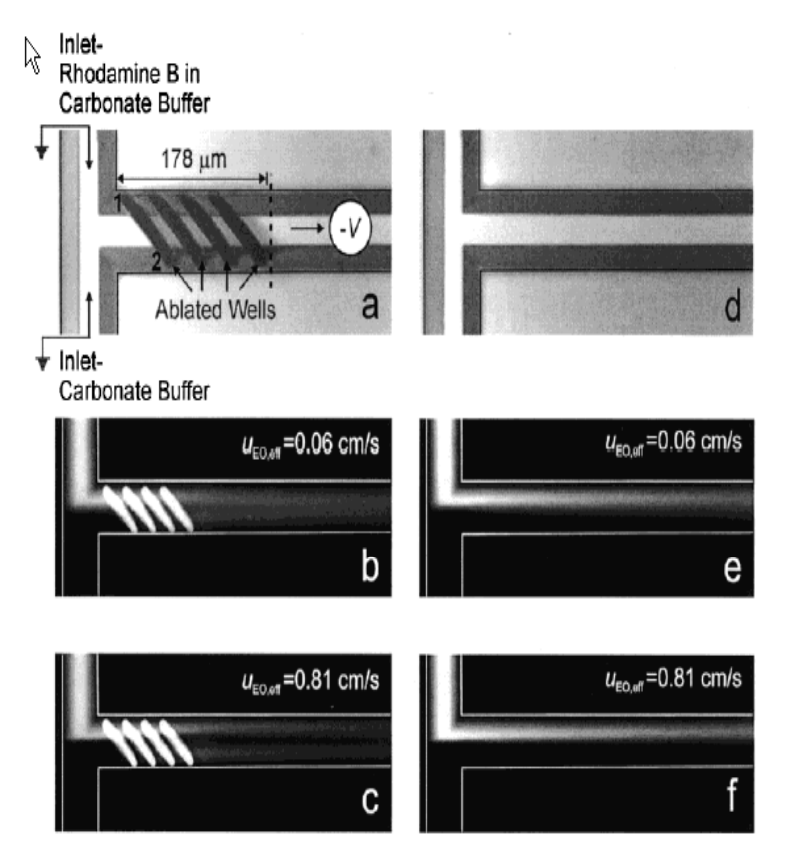
Figure 6. Evolution of design with obstacles in the Y-channel.

Syed Masood *et al.*
Smart Mater. Struct. 11 (2002)

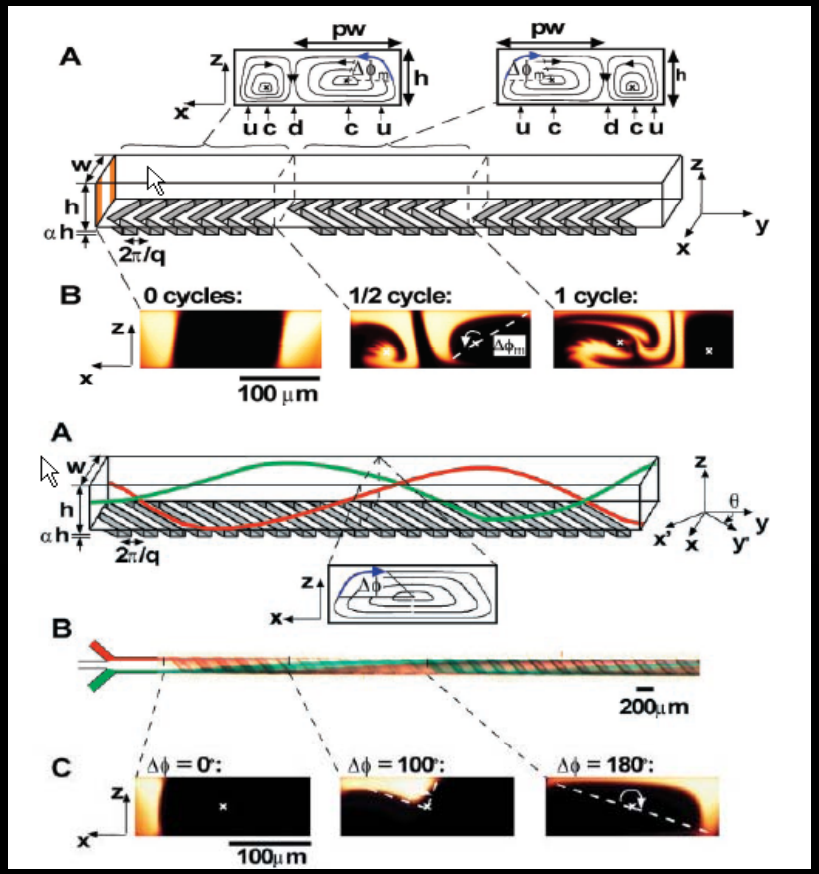


Hubert H. Girault *et al.*
Anal. Chem. 74 (2002)

Chaotic micromixer



Laurie E. Locascio *et al.*
Anal. Chem. 74 (2002)

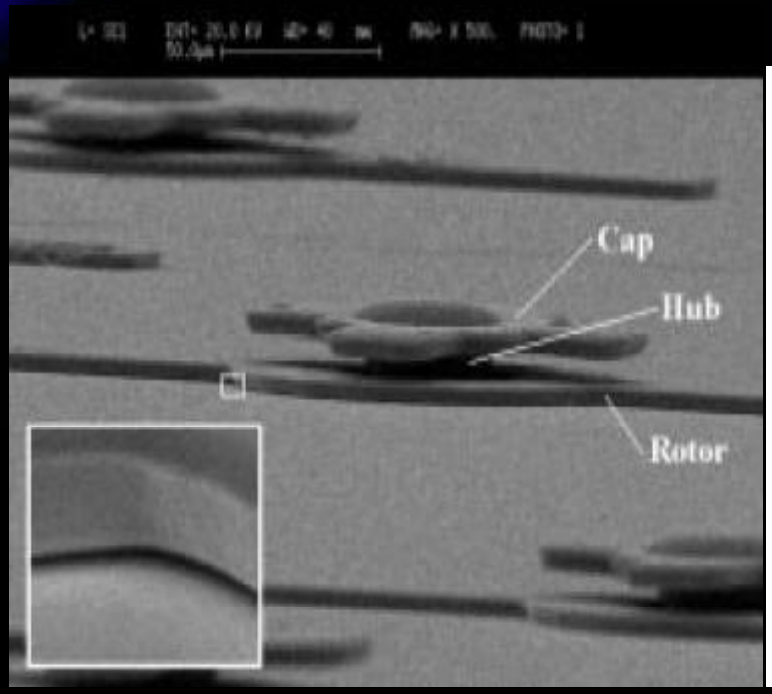


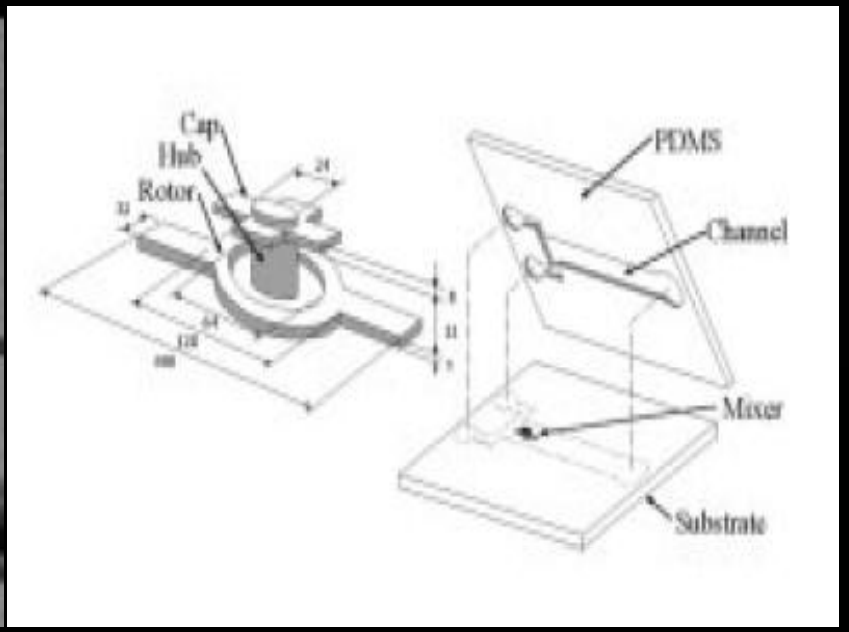
George M. Whitesides *et al.*
Science 295 (2002)

Active Mixing

- **Magnetic microstirrer**

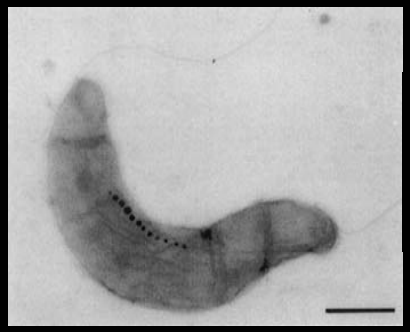
  750μm wide, 70μm deep and 4 mm long



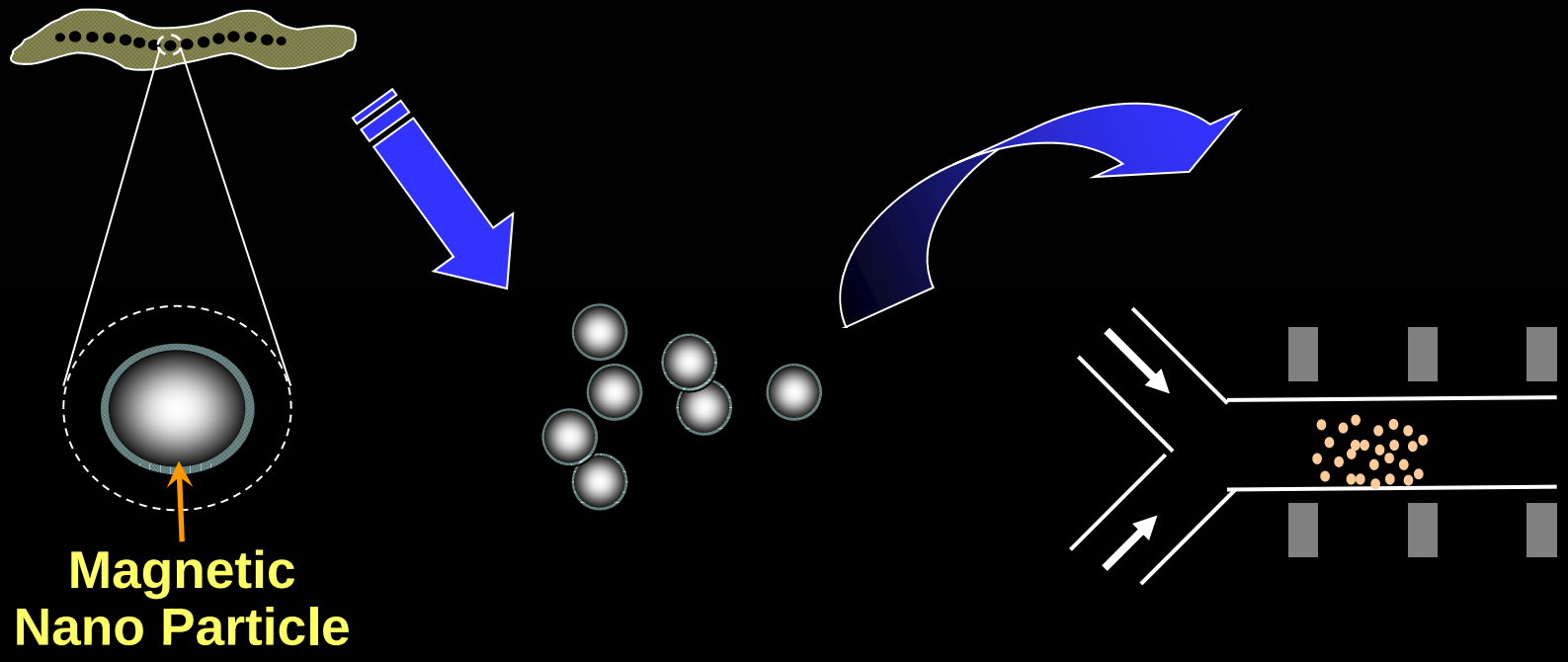


Lu, L. H., Ryu *et al*. Journal of Mems, 11(2002)

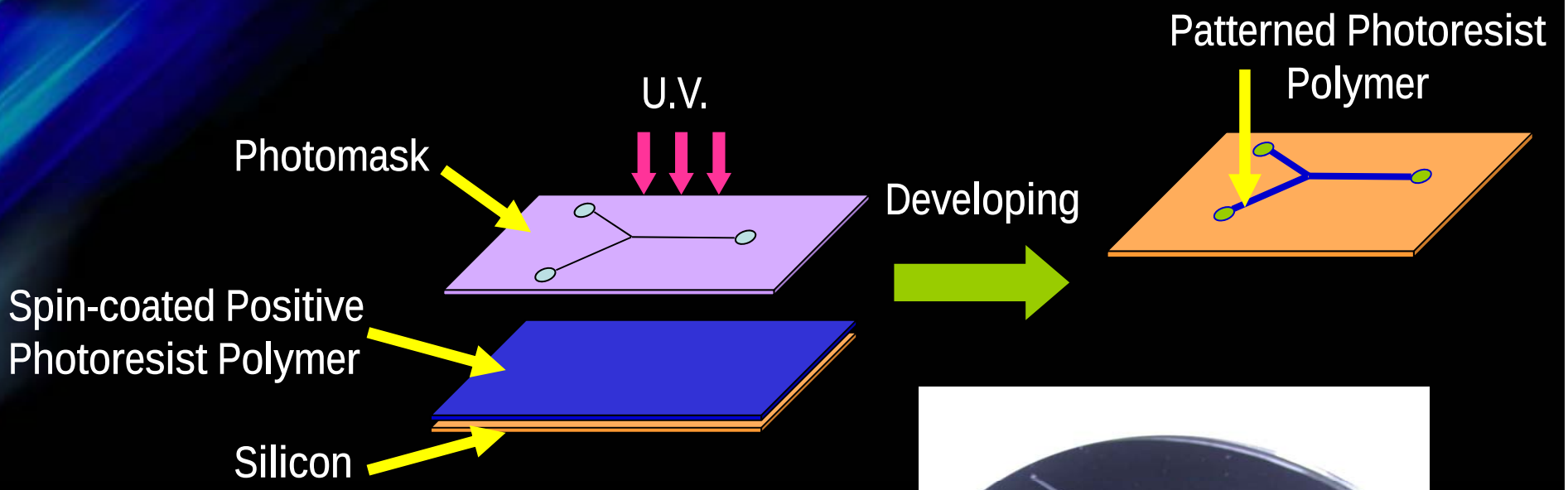
Objectives

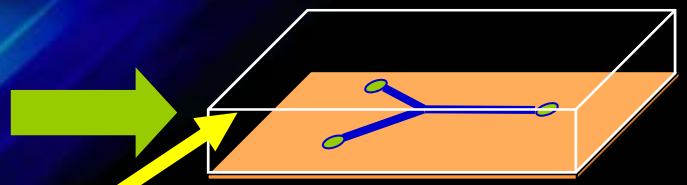


- 마그네틱 박테리아로부터 마그네틱 나노입자 분리
- 미세유체흐름의 혼합에 이용



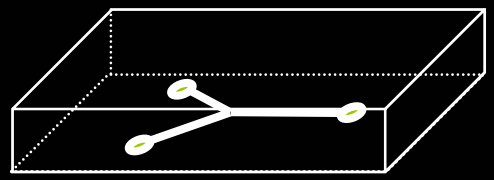
마이크로 채널 및 칩 제작


U.V.
Photomask
Spin-coated Positive
Photoresist Polymer
Silicon
Developing
Patterned Photoresist
Polymer



PDMS

Removing PDMS



Siloxane oligomer *Siloxane cross-linker*

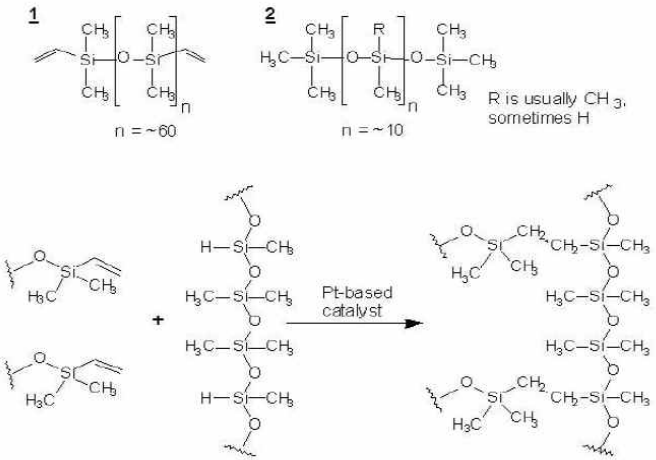
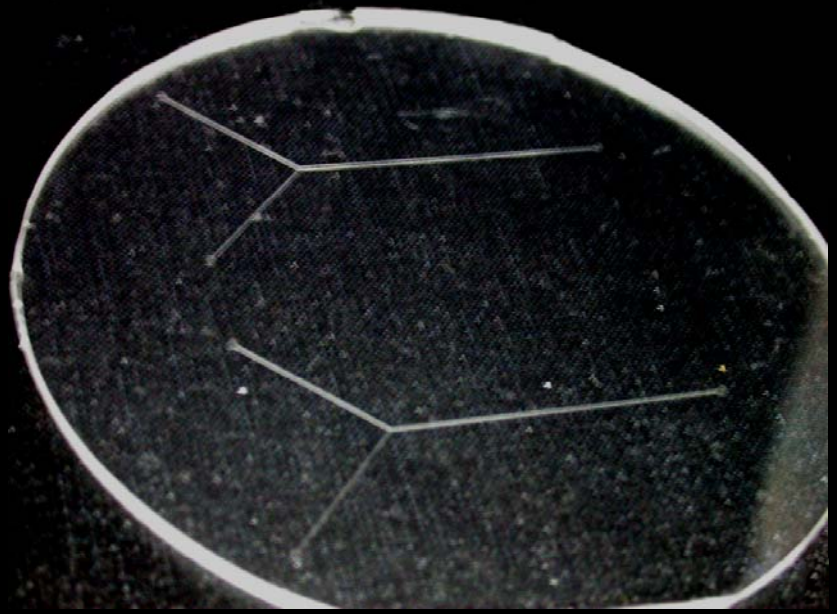
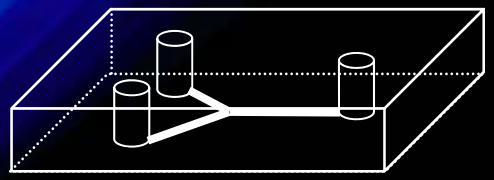
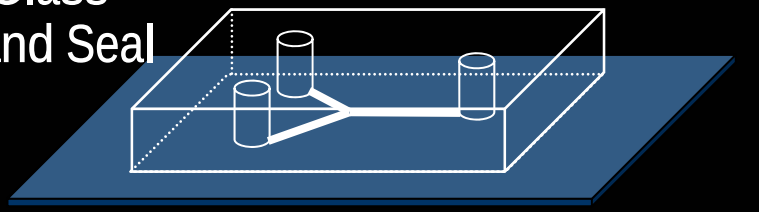


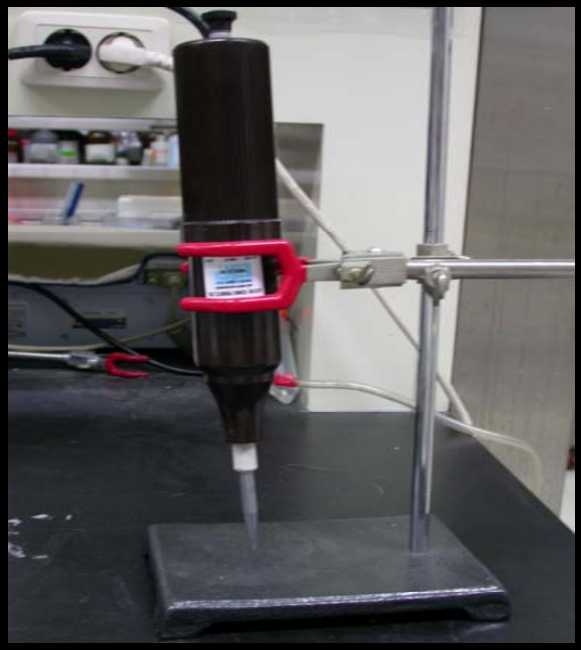
Figure 2 PDMS curing by polymerisation

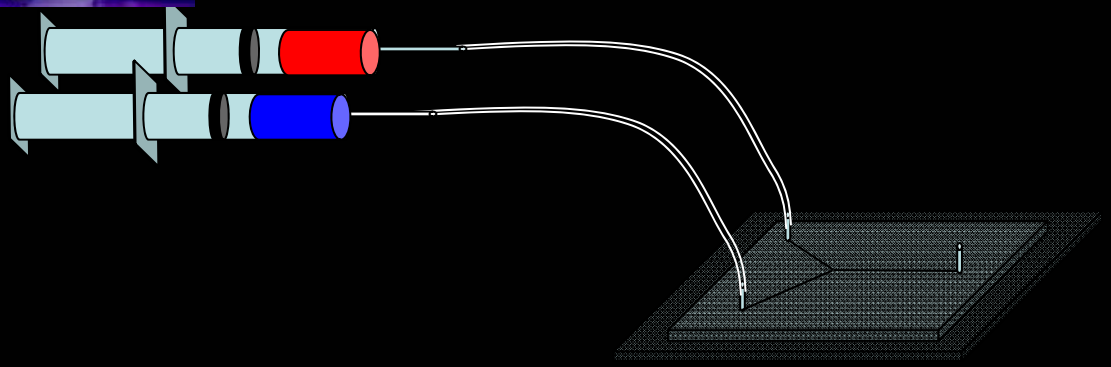


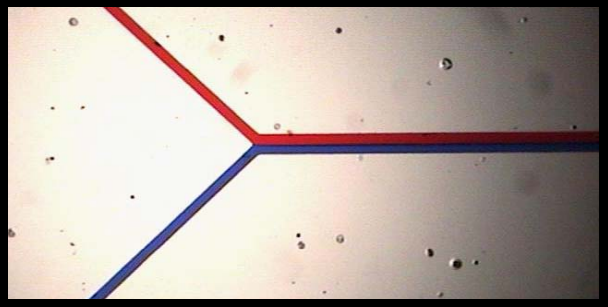


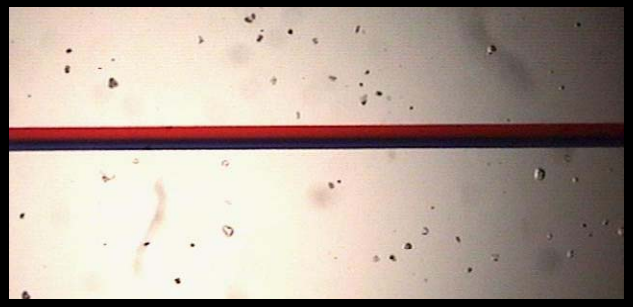
Oxidize PDMS and Glass Substrate in Plasma and Seal

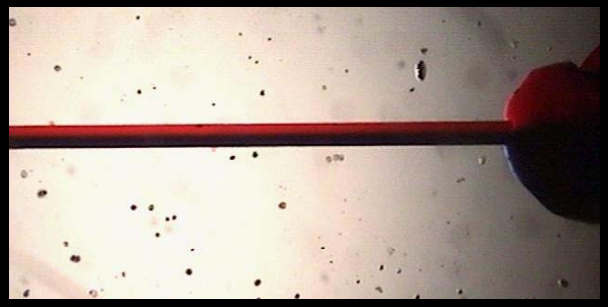




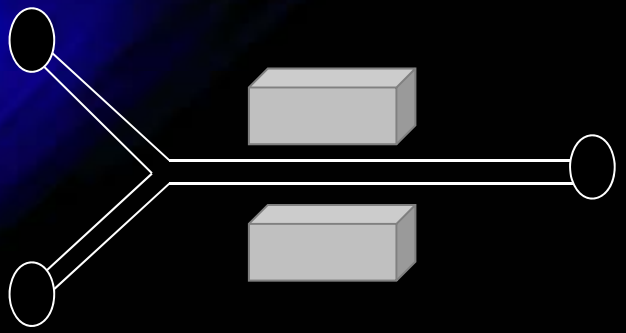


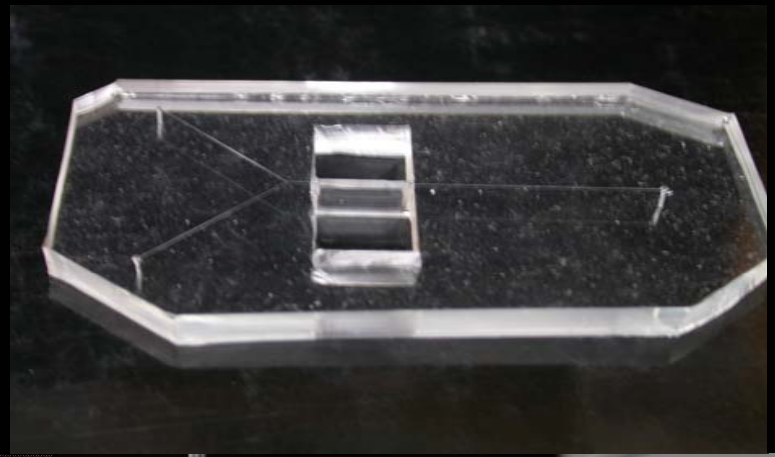


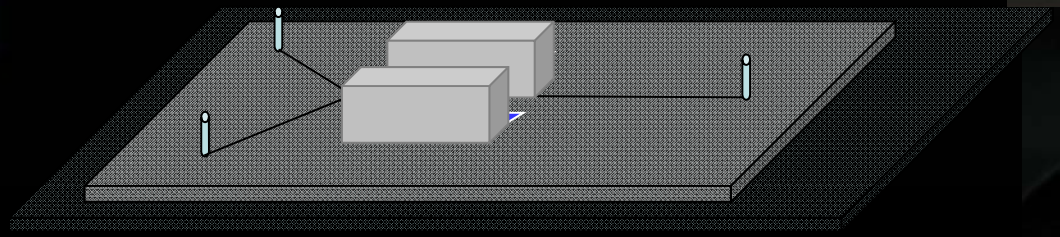


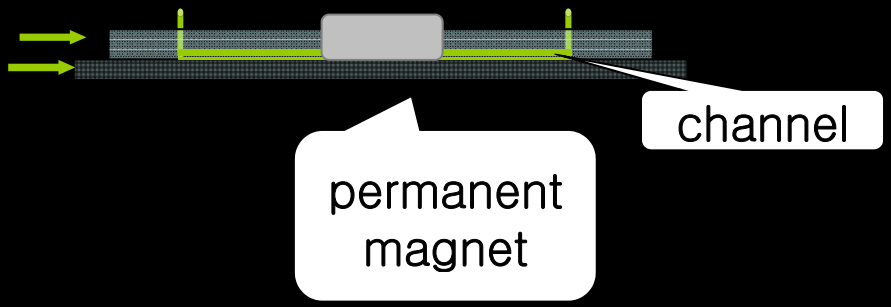


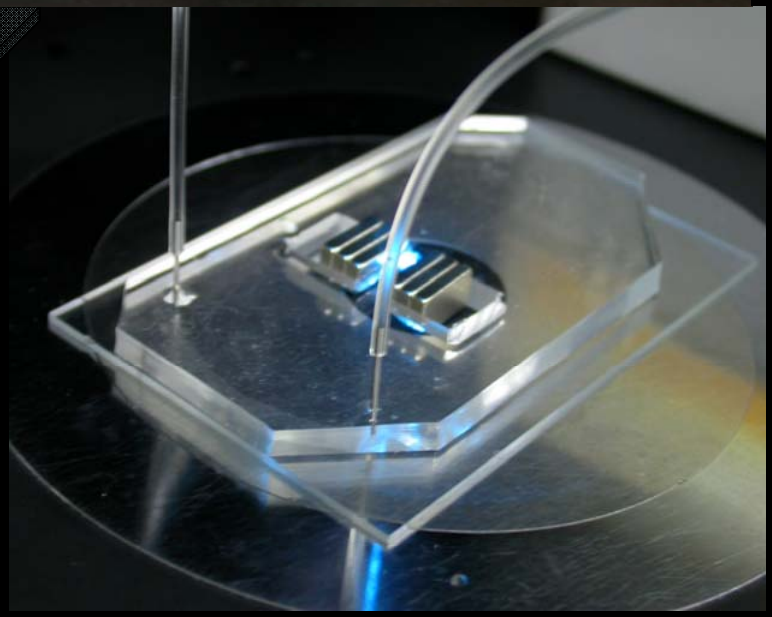
자성 나노입자를 모으기 위한 마이크로 칩의 제작



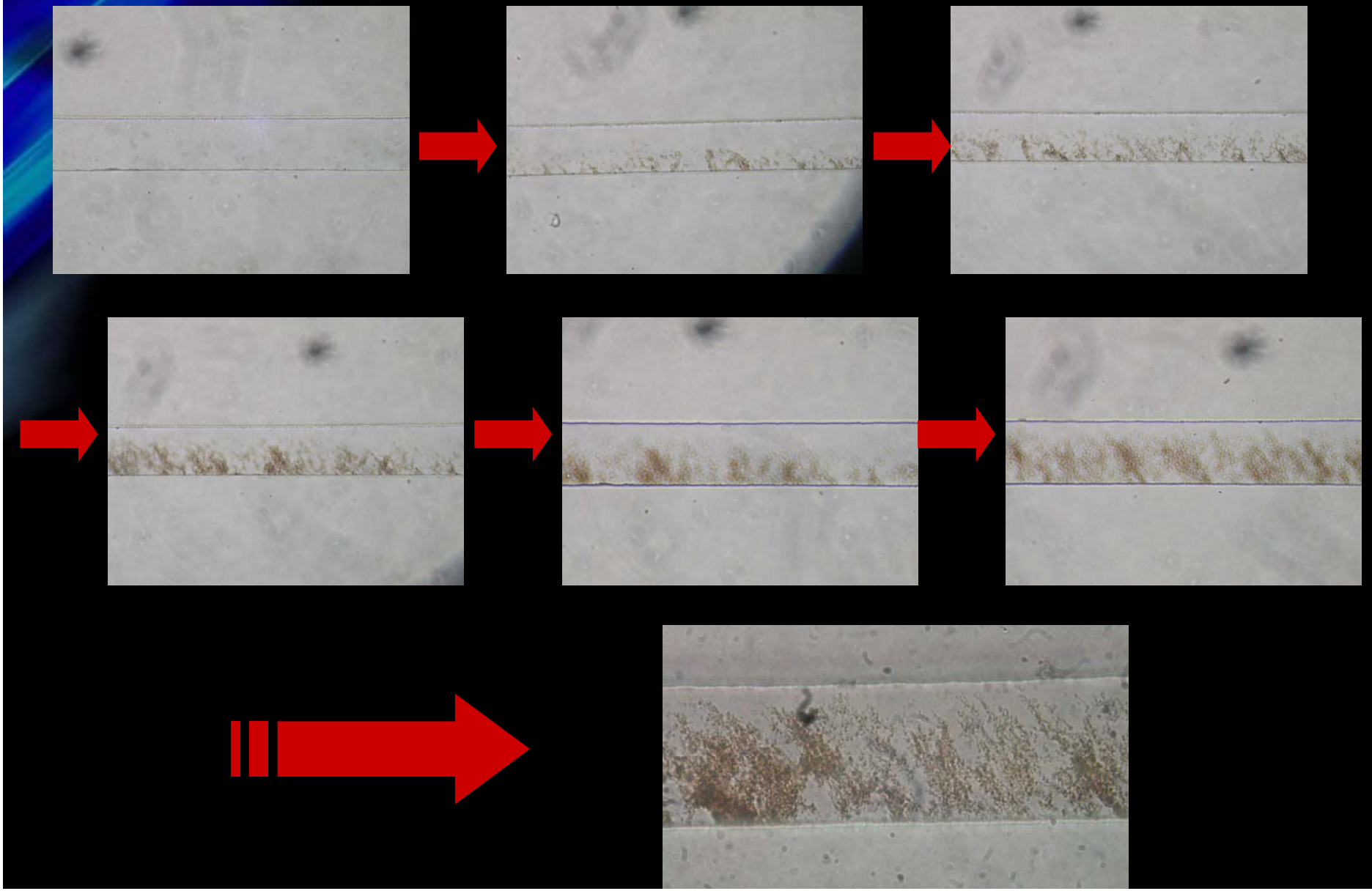






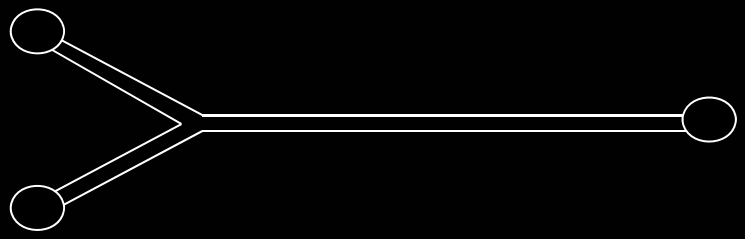


채널 내로 자성 나노입자 도입

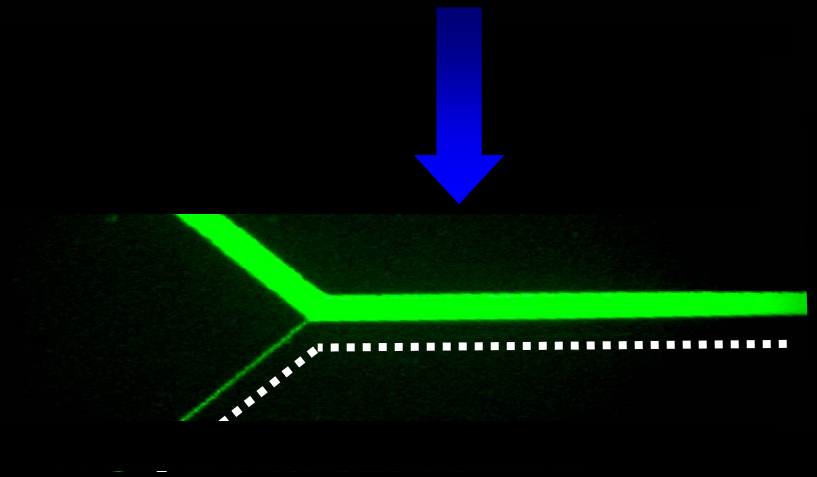


0.3μM FITC-dextran

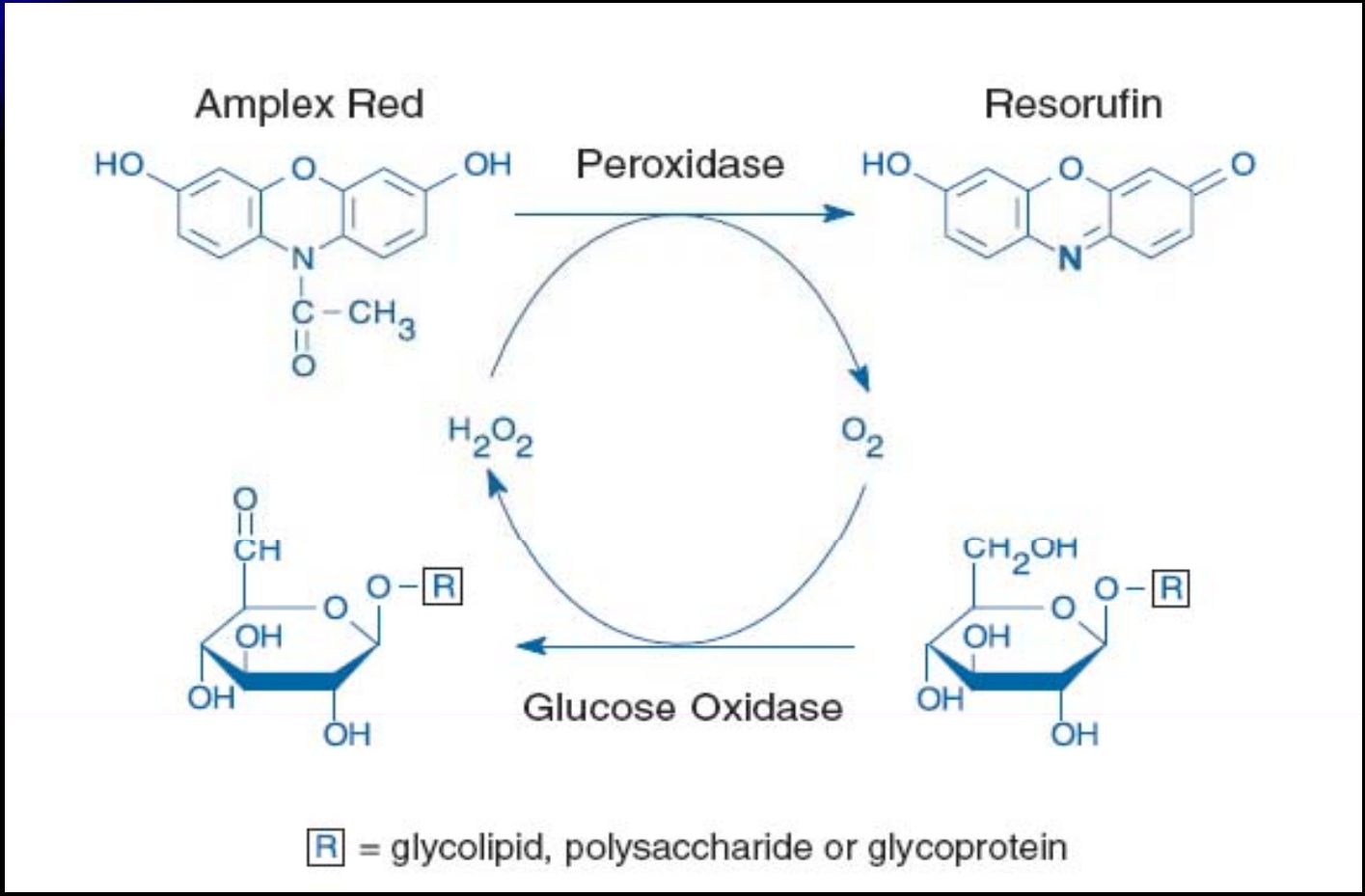
50mM Tris-HCl buffer (pH 7.5)



50mM Tris-HCl buffer (pH 7.5)

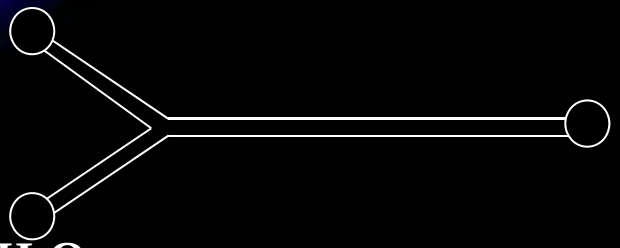


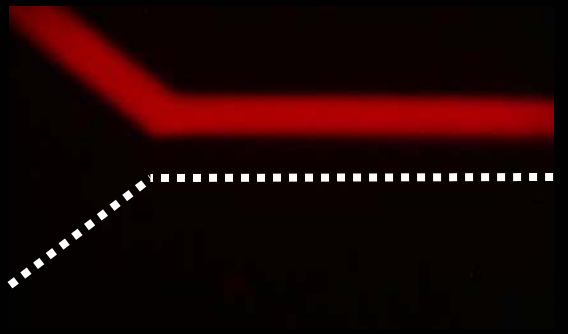
혈당 측정을 위한 포도당 검출용 칩



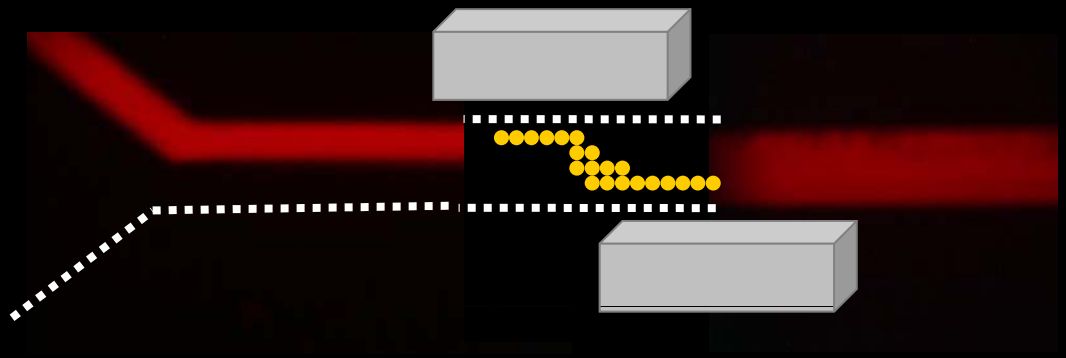
미세유체 혼합기술의 응용

10μM Amplex Red + horseradish peroxidase
50mM Tris-HCl buffer (pH 7.5)





10μM H_2O_2 +
50mM Tris-HCl buffer (pH 7.5)



미세유체 혼합기술을 이용한 포도당 검출