

연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

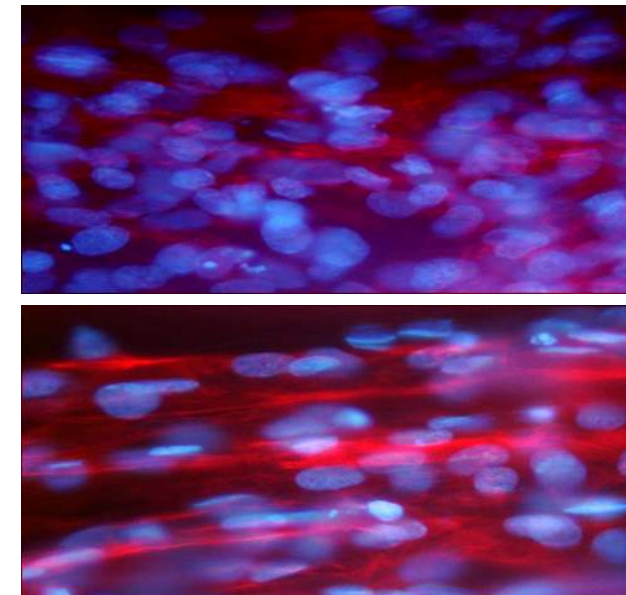
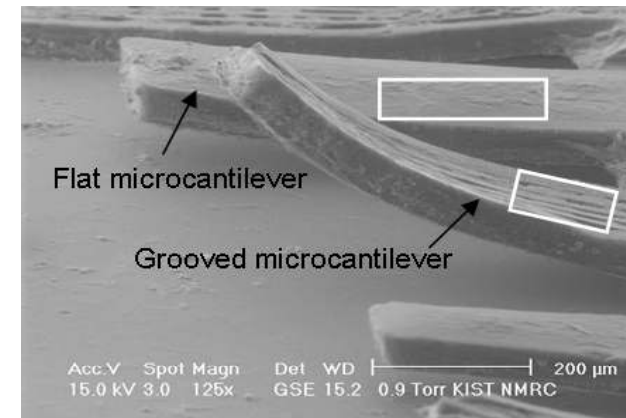
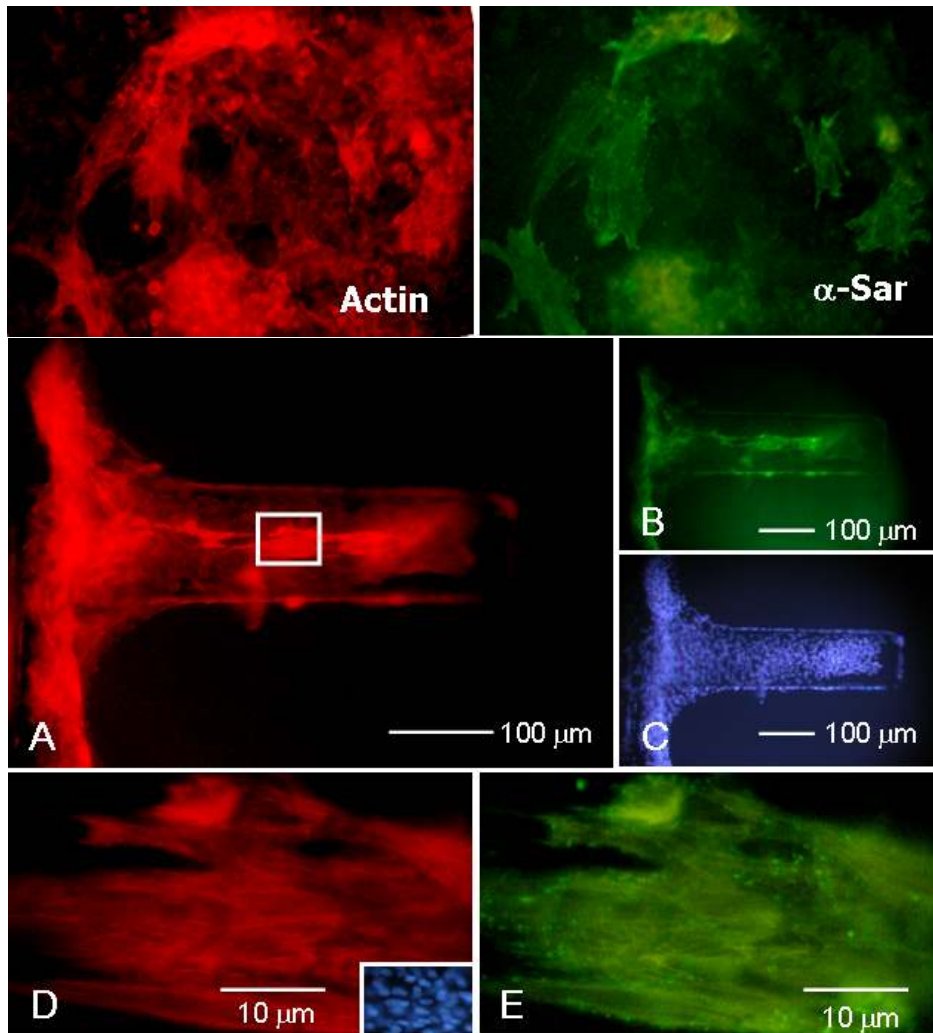
Biohybrid system

- Biohybrid system
 - A device that marries biologic units—eg, cells or tissues, to a delivery vehicle to circumvent—through immunoisolation—immune attack on transplanted—non-self tissues. (e.g. Artificial liver, Artificial pancreas) [medical-dictionary]
 - Consists of biological organisms and artificial systems to use the both benefit from the two systems.
- Development of Hybrid Biopolymer Actuator
 - Our goal is developing a self-assembled muscle powered hybrid biopolymer actuator: Glucose → ATP → Mechanical Energy
 - However, it need more force to generate large displacement → How can we increase it??
- Sensors for Quantitatively Analysis of Contractile Force
 - Biologist have been tried provide groove surface for cells to resemble their *in vivo* circumstance

연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

Cell Morphology Analysis

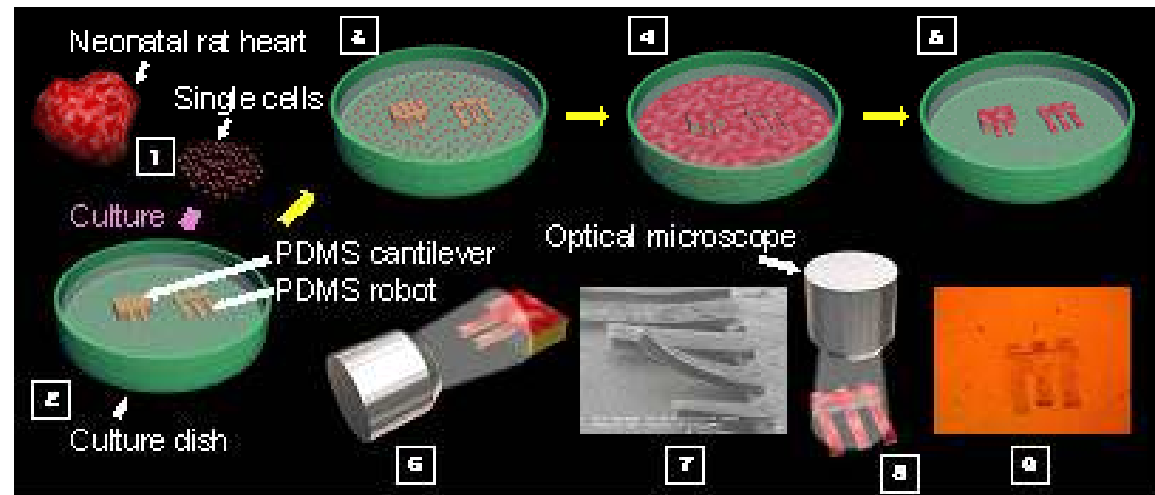
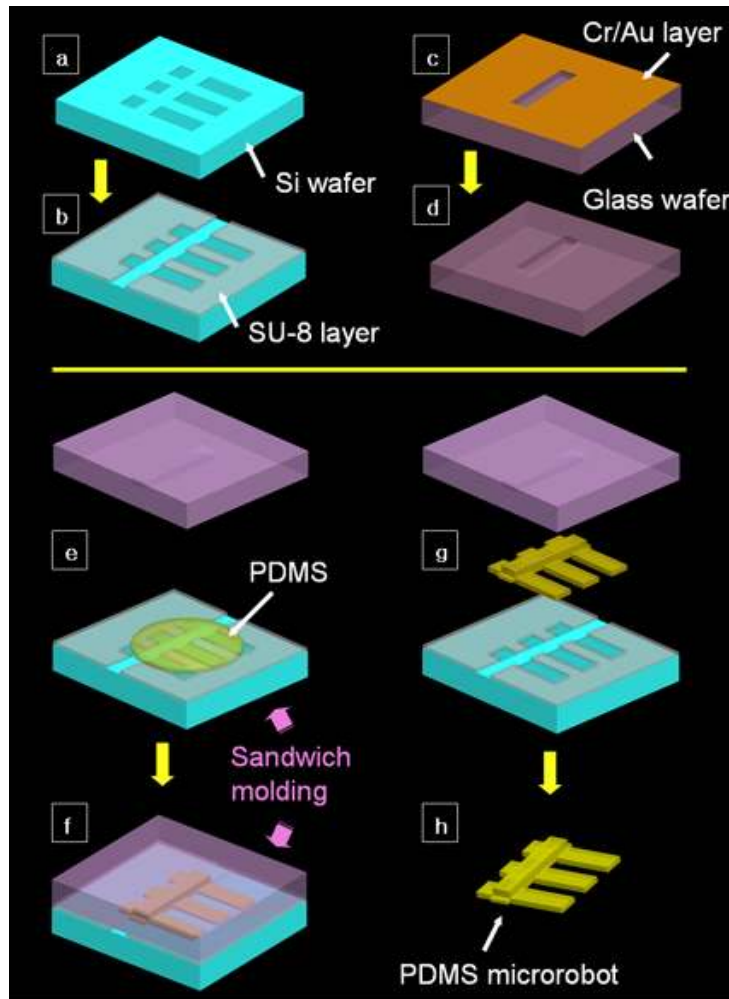


J. Park et al., *Anal Chem*, 2005, *JMM* 2006

연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

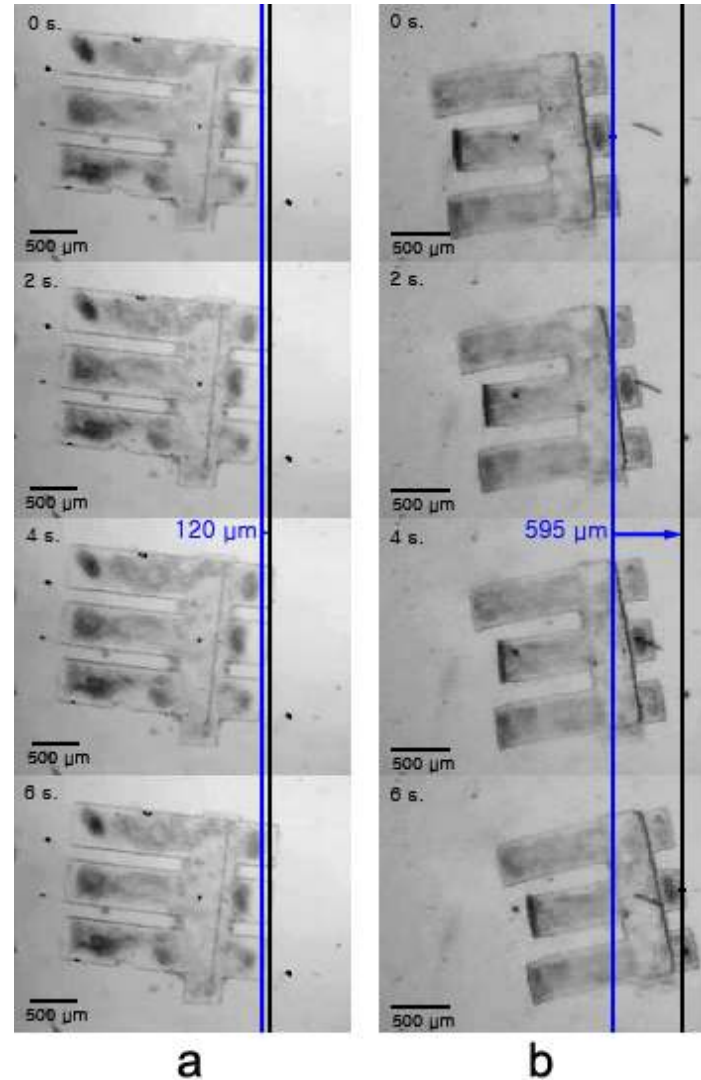
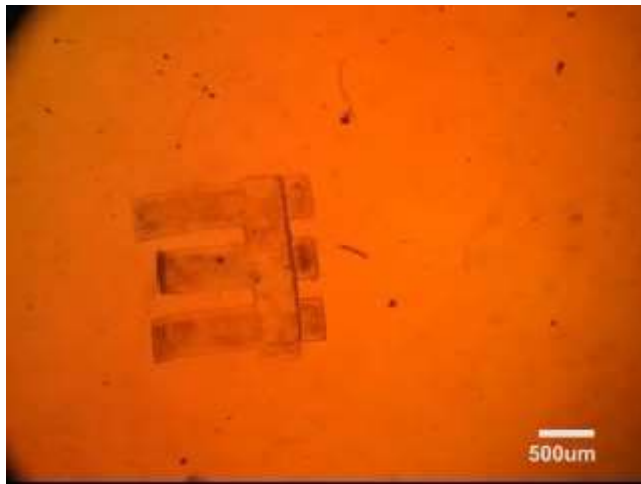
Fabrication of Hybrid Microrobot



연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

Movements of Hybrid Microrobot

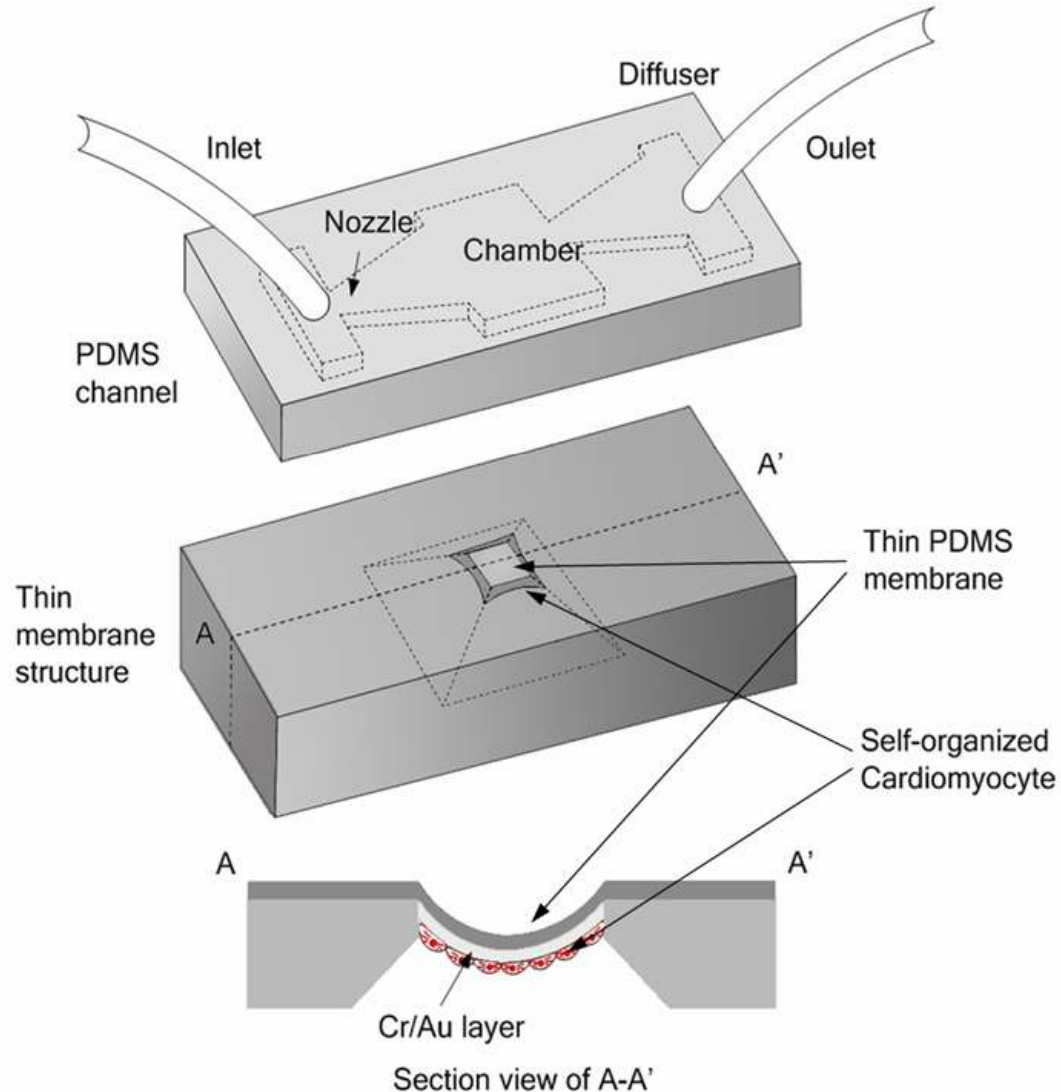


연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

Micropumping by

- Design of efficient electrical charges/
- Conventional Microfluidics
 - requires external power source (e.g. piezoelectric, or pneumatic)
 - Not easy to use
- Cell based Hybrid Microfluidics
 - Activated from chemical energy (e.g. Glucose → ATP)
 - Musclebot [Mote]
 - Hybrid Biopolymer



tes to high
1]

ic,

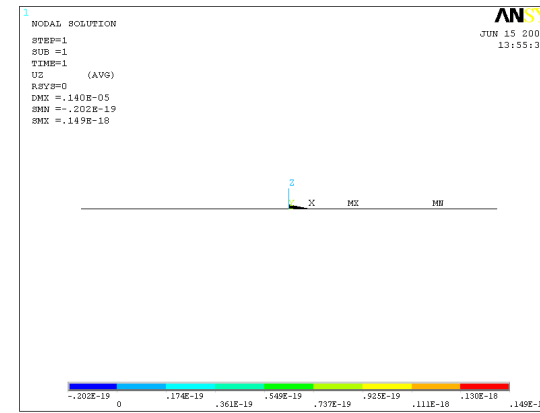
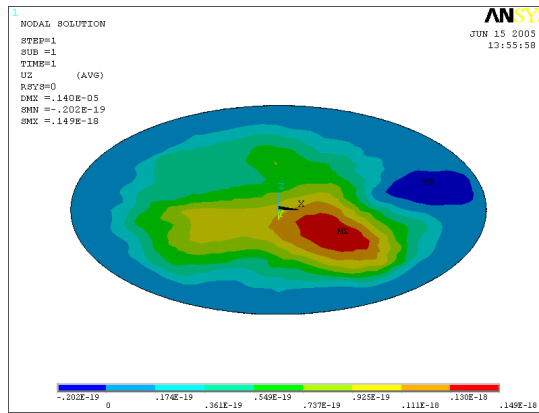
ce

연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

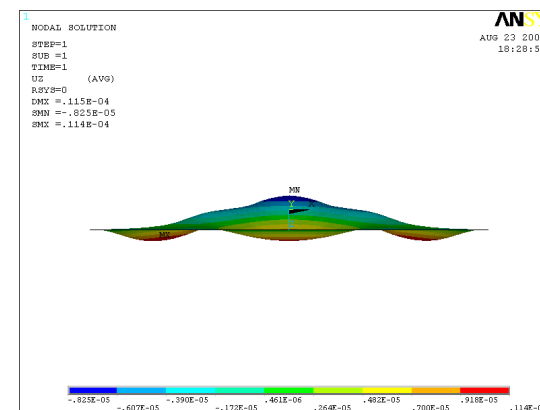
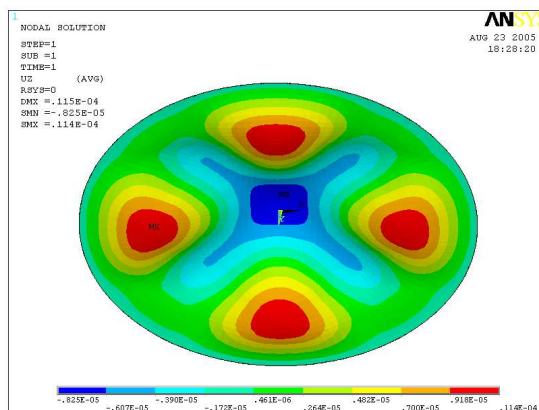
Biohybrid system

Dome Shaped Membrane

Vertical displacement of flat membrane



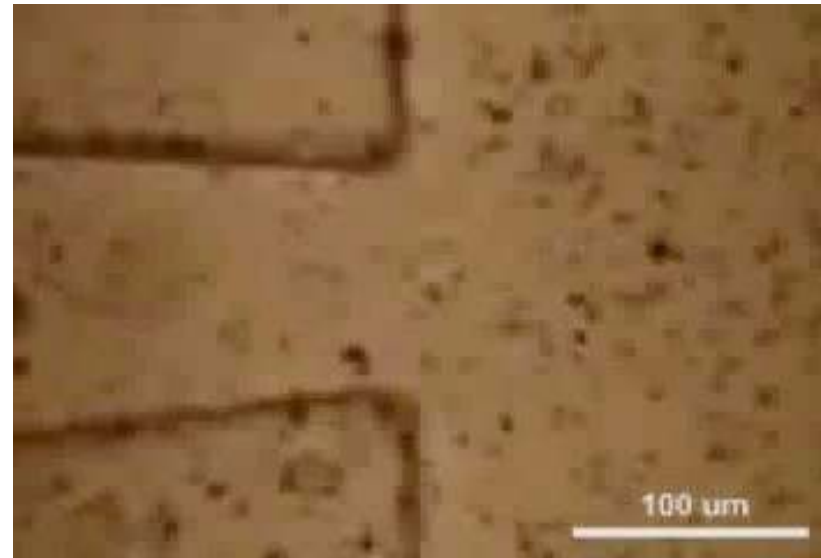
Vertical displacement of dome shaped membrane



연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

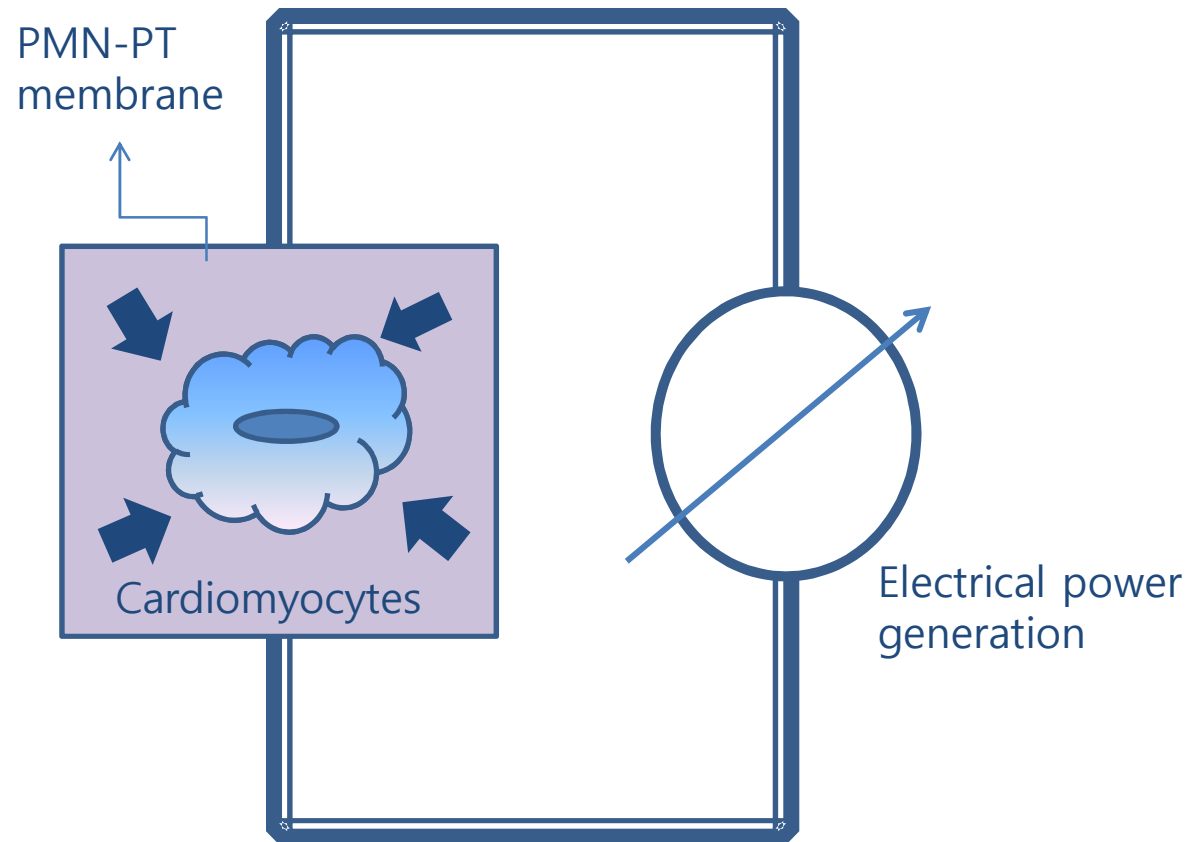
Experimental Results for Micropumping



연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

MEMS-based Energy Harvesting System Using Self-organized Heart Muscle Cells



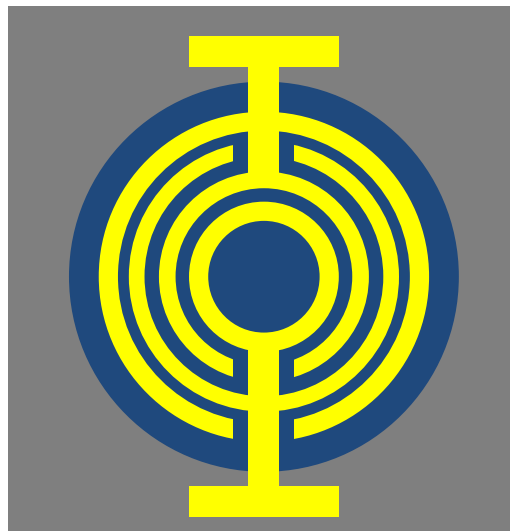
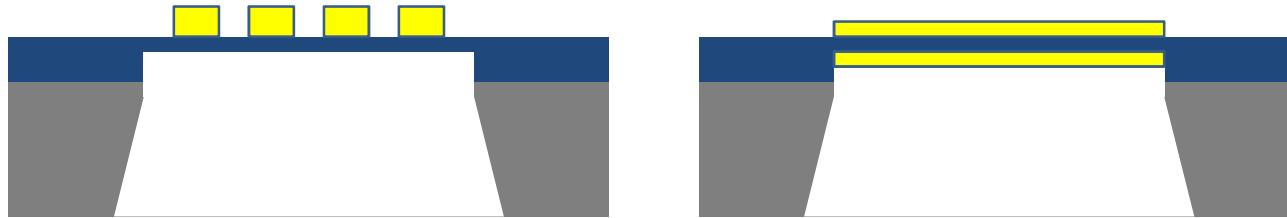
Concept of electrical power generation using cardiomyocytes

연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

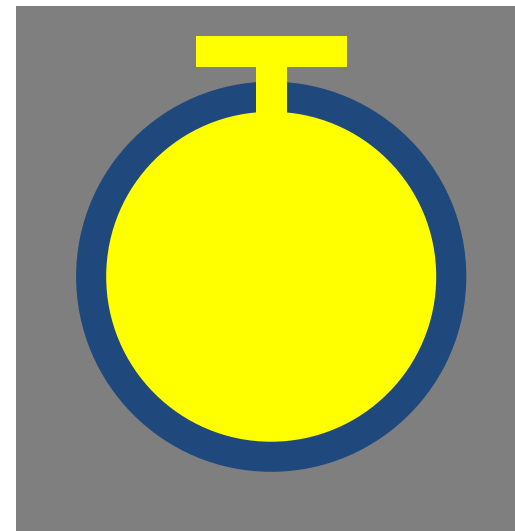


Biohybrid system

PMN-PT diagram with interdigitated electrode



(a) d_{33} mode



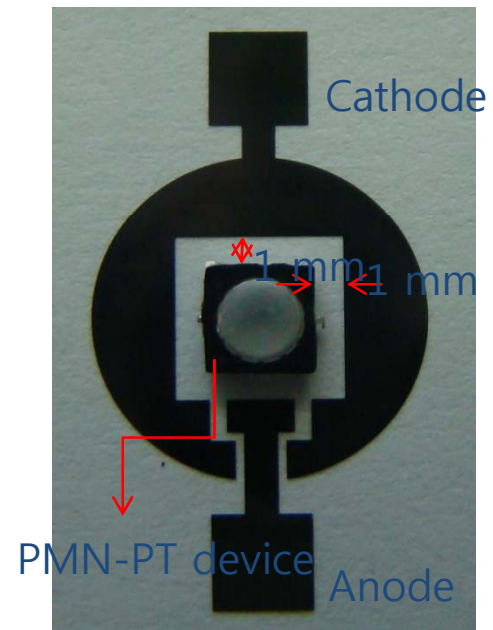
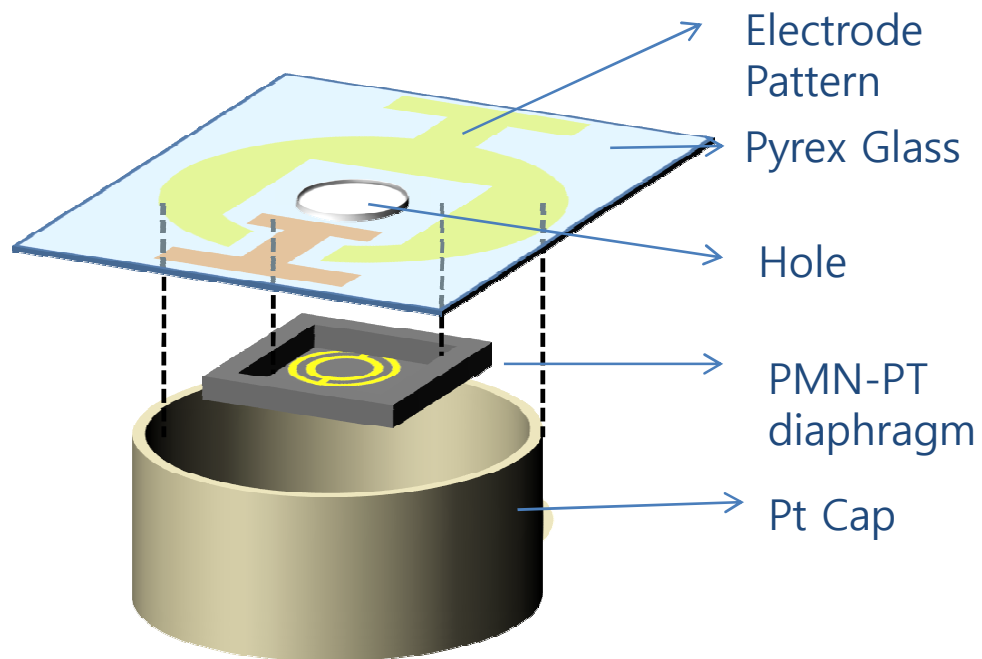
(b) d_{31} mode

	d_{33} (pC/N)	d_{31} (pC/N)	K
PMN-PT	2285	-1063	90%

연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

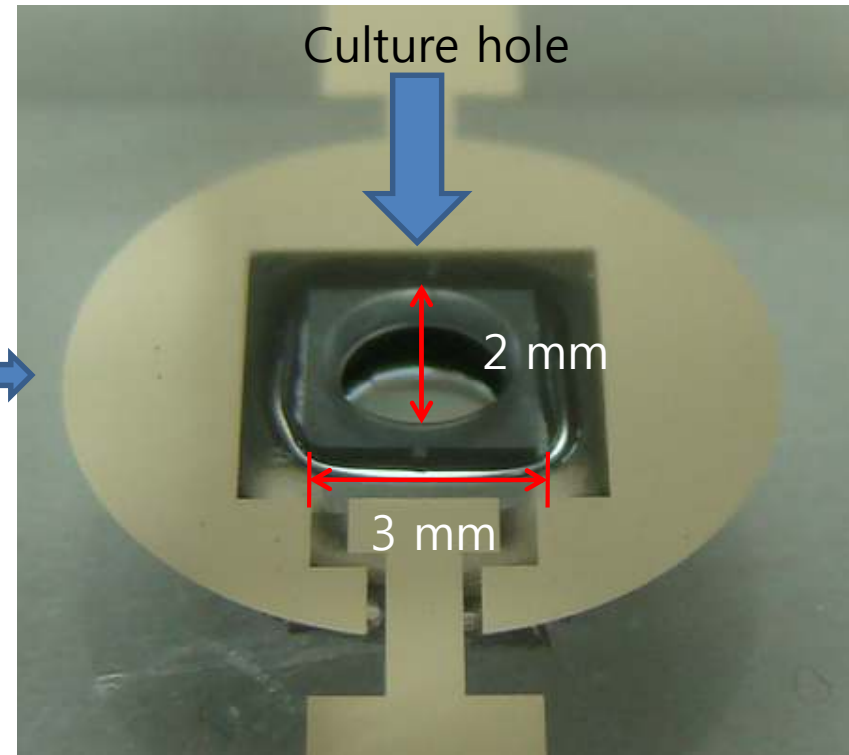
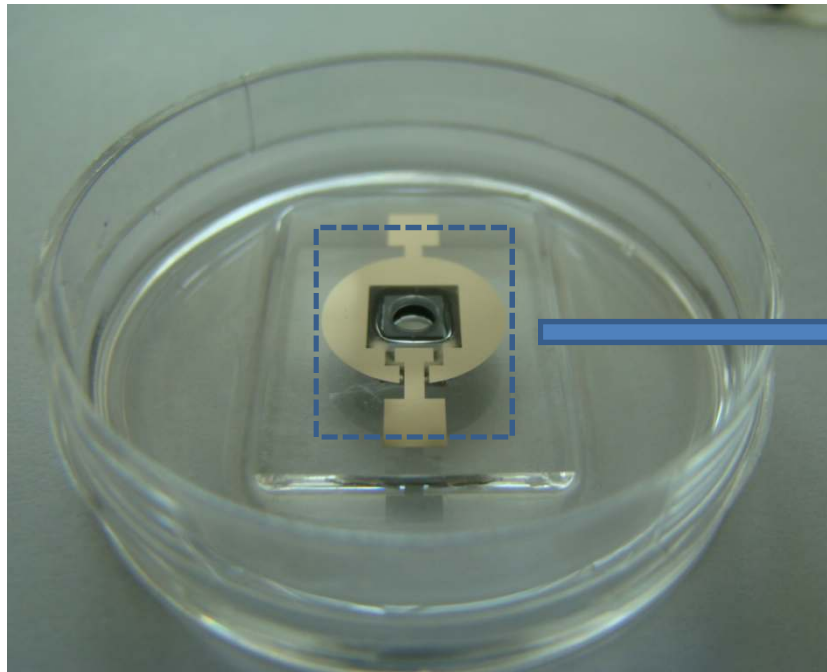
Power generation using activation of cardiomyocytes on a PMN-PT diaphragm



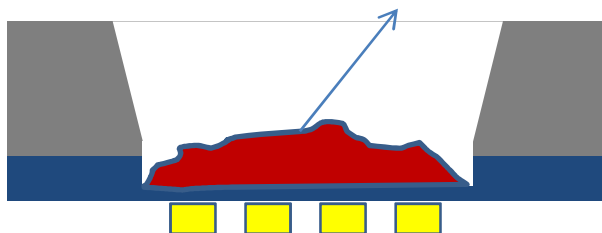
연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

Power generation using activation of cardiomyocytes on a PMN-PT diagram



Heart muscle cell



연구분야 4. 심장세포를 이용한 에너지 하비스트 소자 개발

Biohybrid system

- Output signals of voltage from the piezoelectric effects of PMN-PT membrane

