A Microfluidic Device for Electrofusion of Biological Membranes

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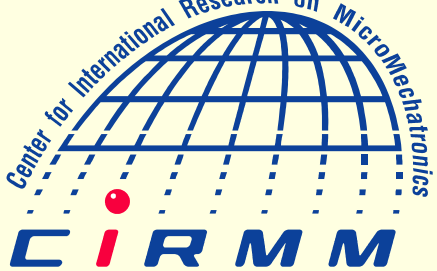


Framework

Electrofusion of liposomes and cells in a MEMS device

Electrofusion

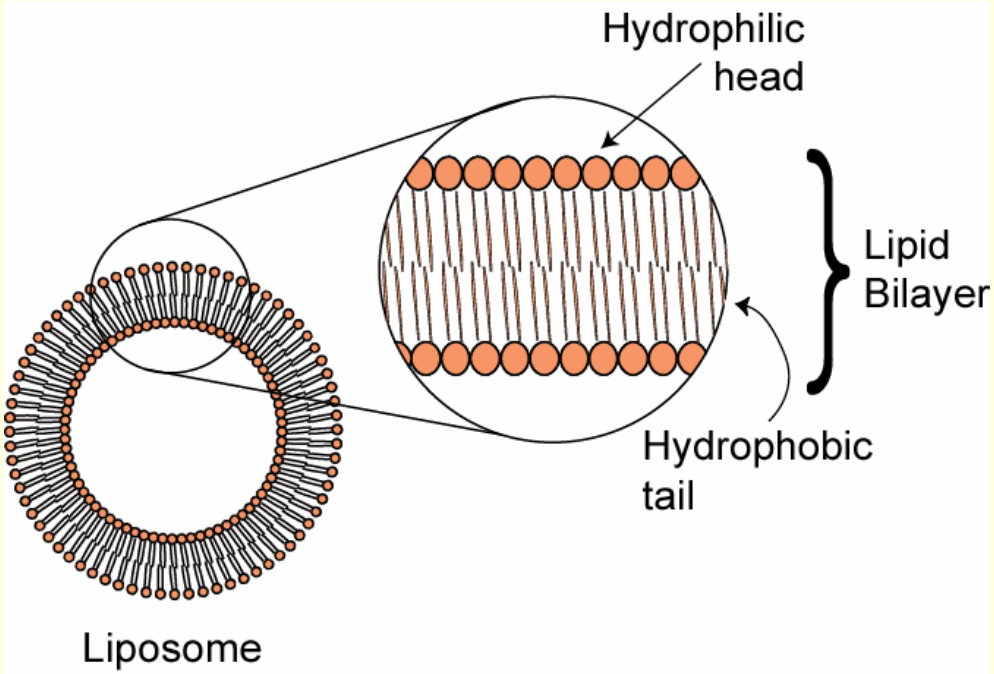
Hybrid cell production

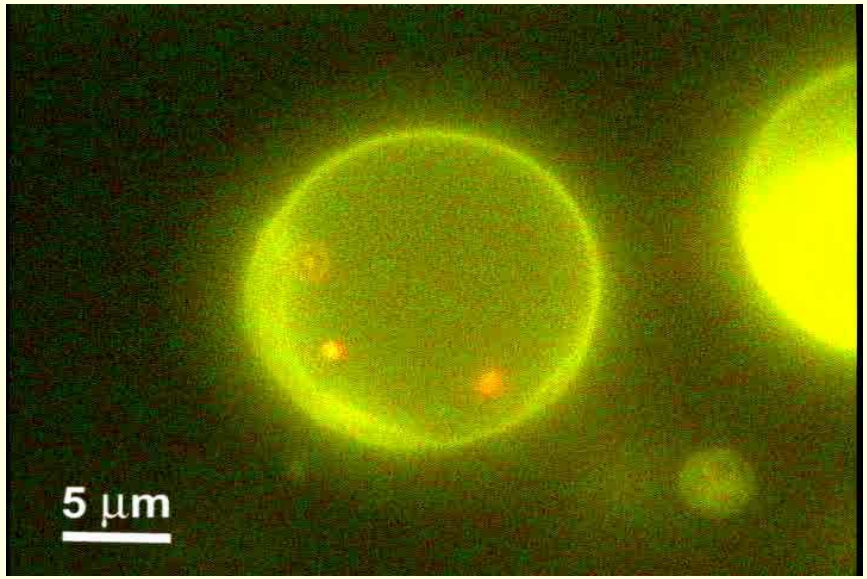
MEMS

- **Lab-on-a-chip** integration
- **Power** reduction
- Future industrial **fabrication**

What Is a Liposome ?

Synthetic lipid-bilayer container

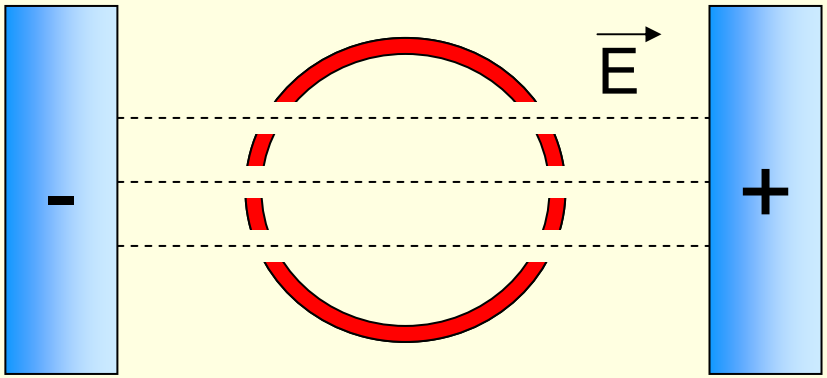




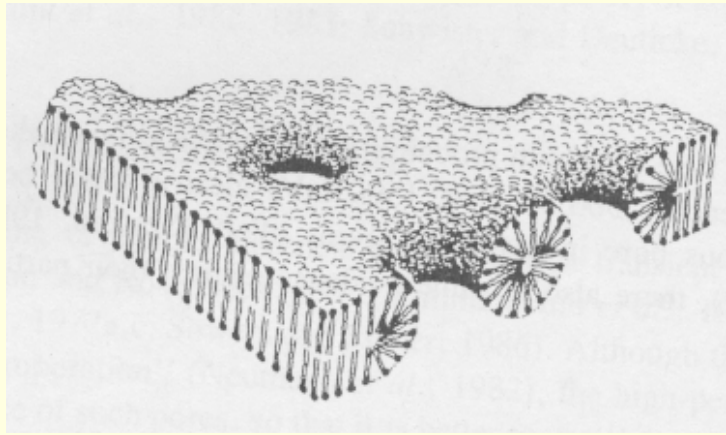
- **Cell-like** membrane structure
- Ability to **enclose** materials

→ Drug, biological and artificial material delivery into cell

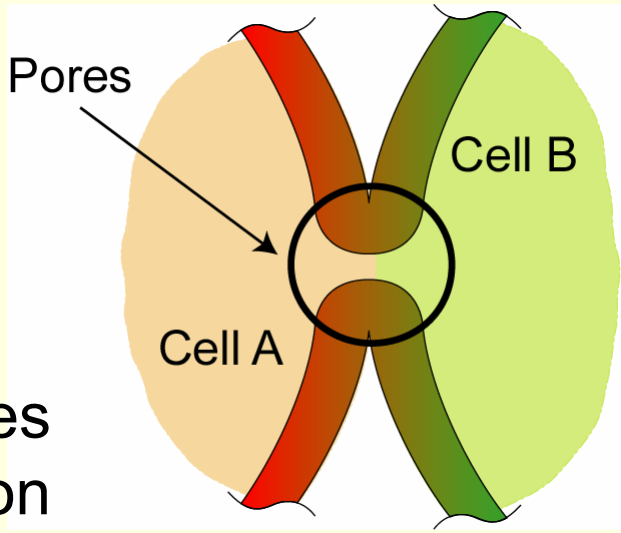
Principle of Electrofusion



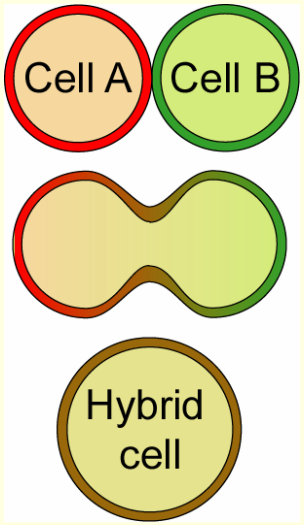
Electroporation: E ≥ 1 kV.cm^{-1}



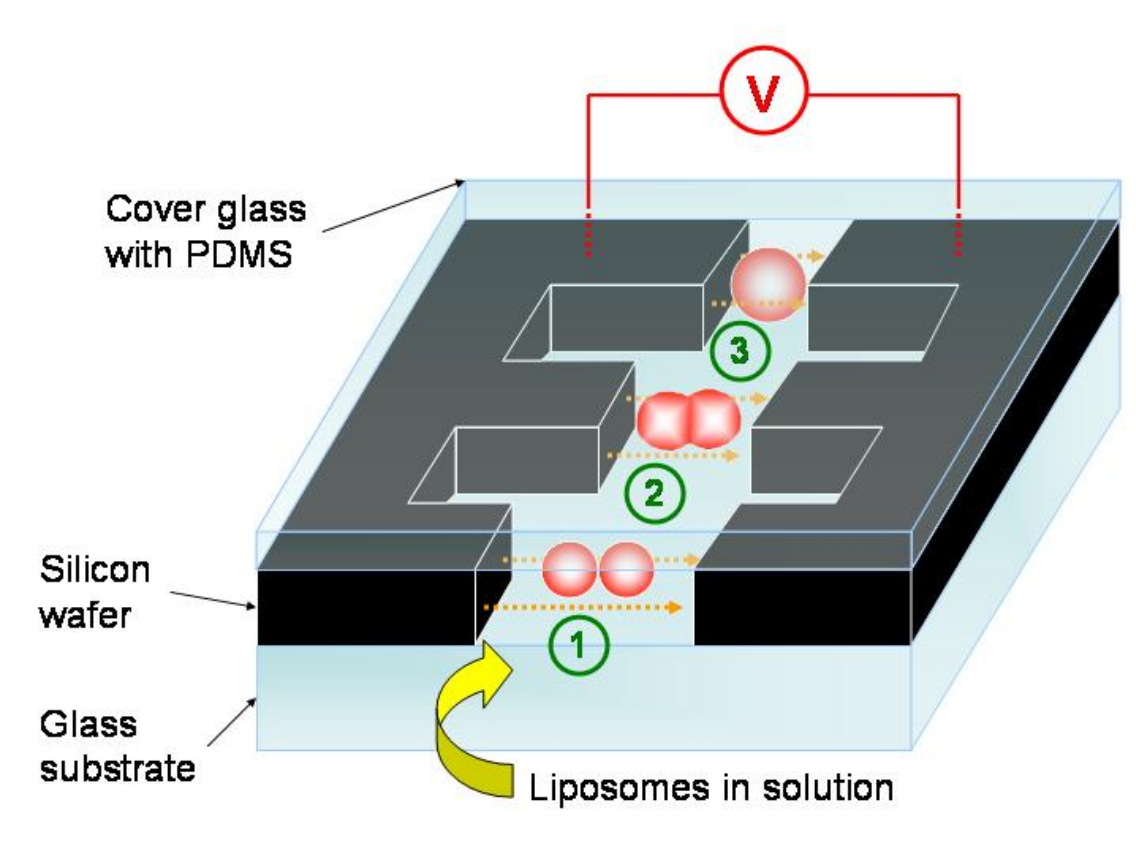
Pore size: 10-100 nm

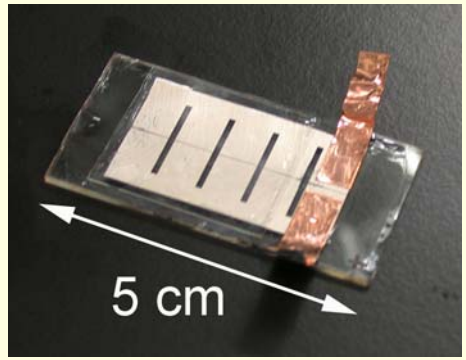


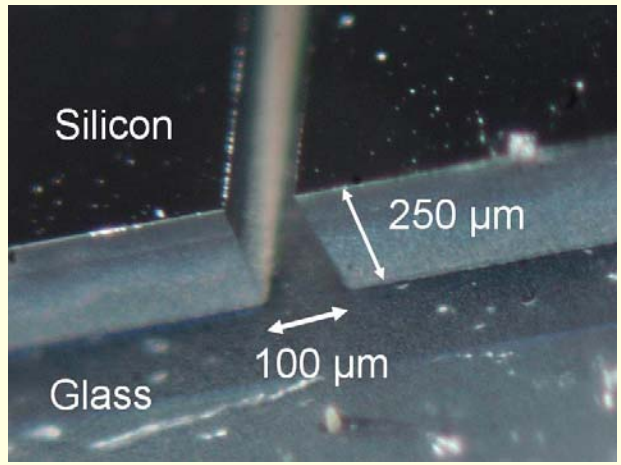
Pores connection



Microdevice Design

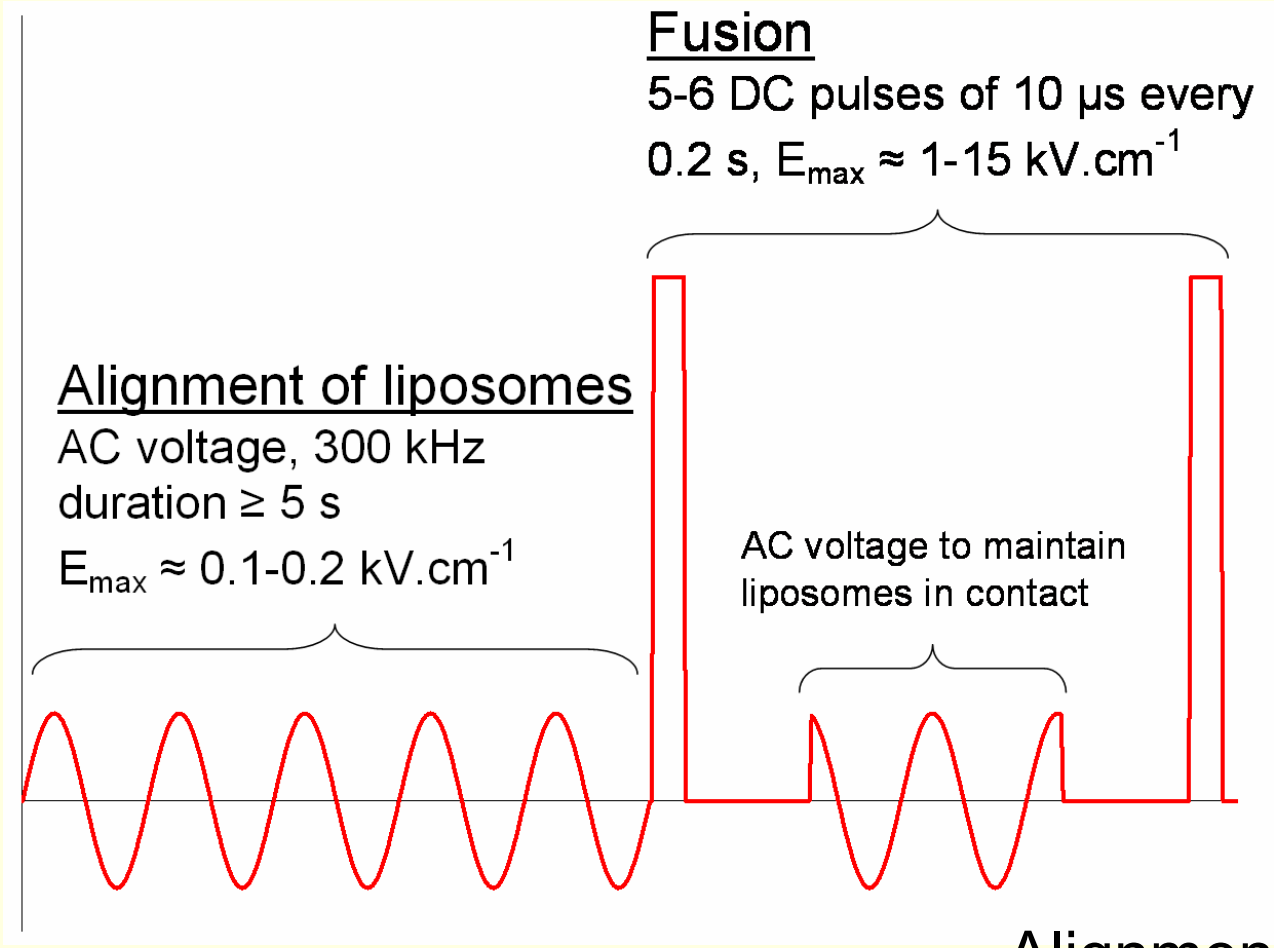


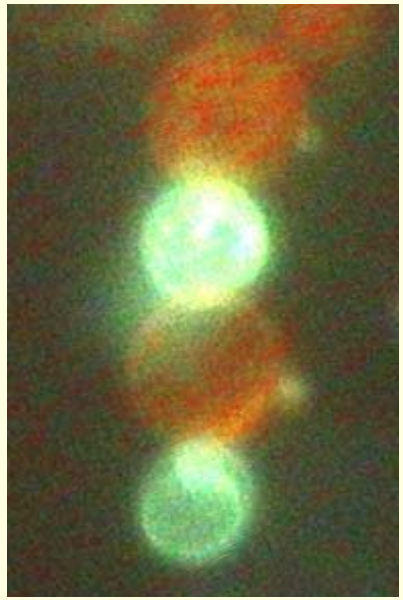


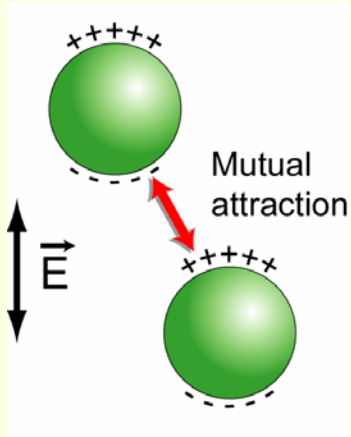


- Reduction of **power consumption**
- **Easy** to fabricate

Electrofusion Protocol

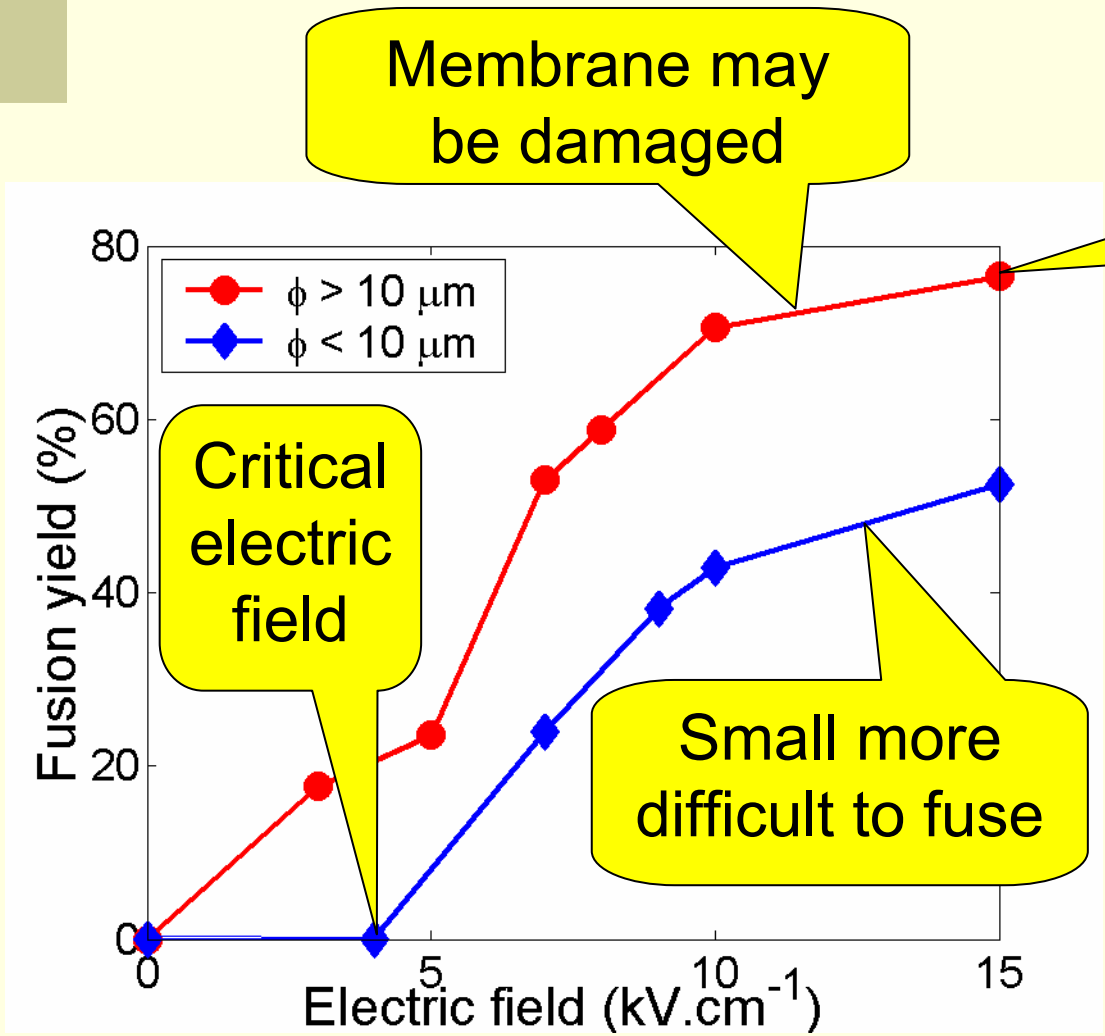


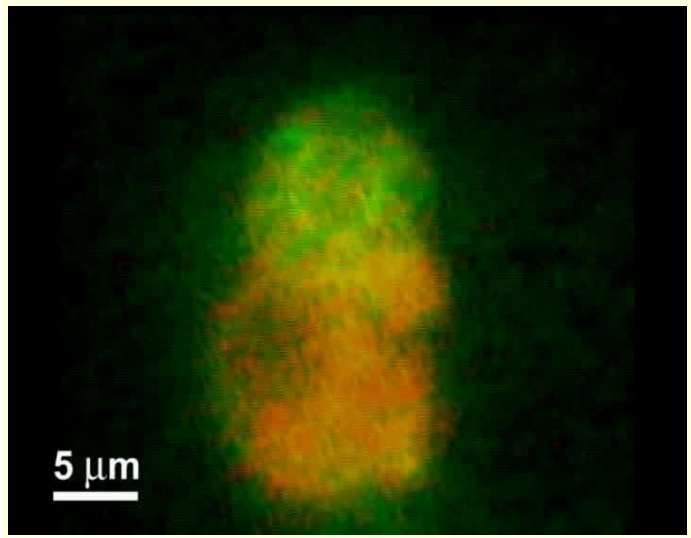




Alignment of polarized vesicles

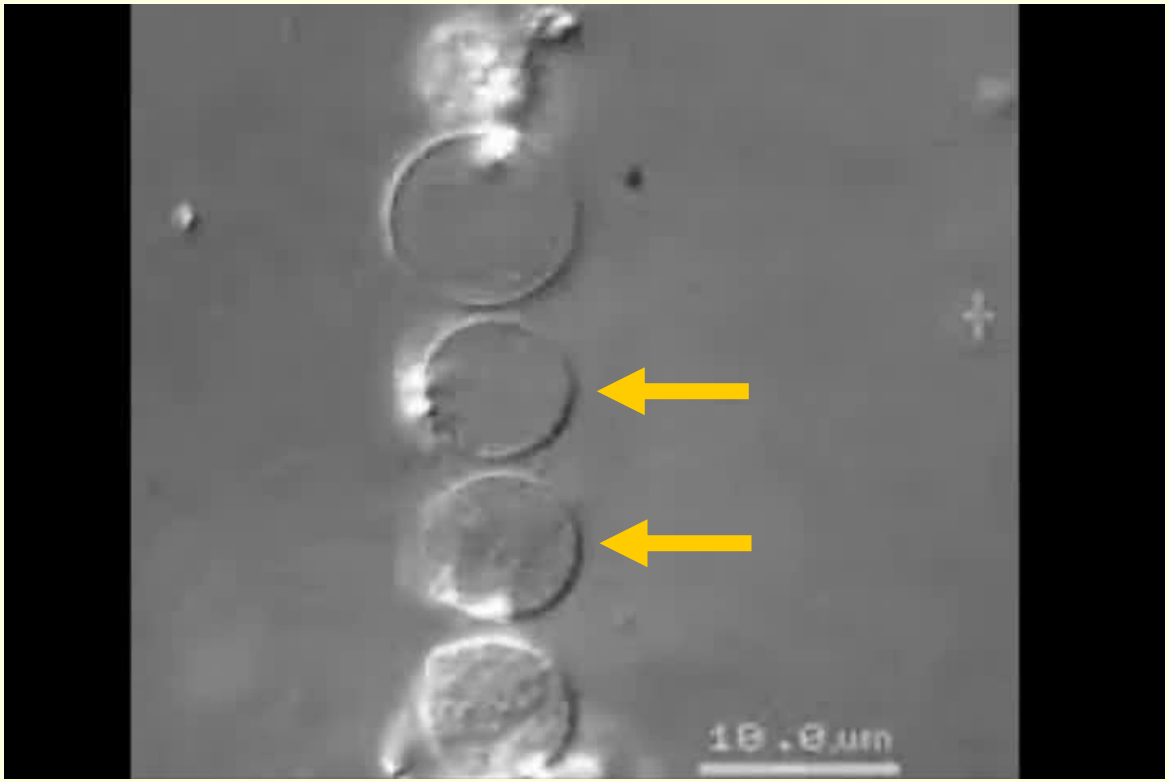
Liposome Fusion





Electrofusion of fluorescent liposomes

Electrofusion of Bacteria

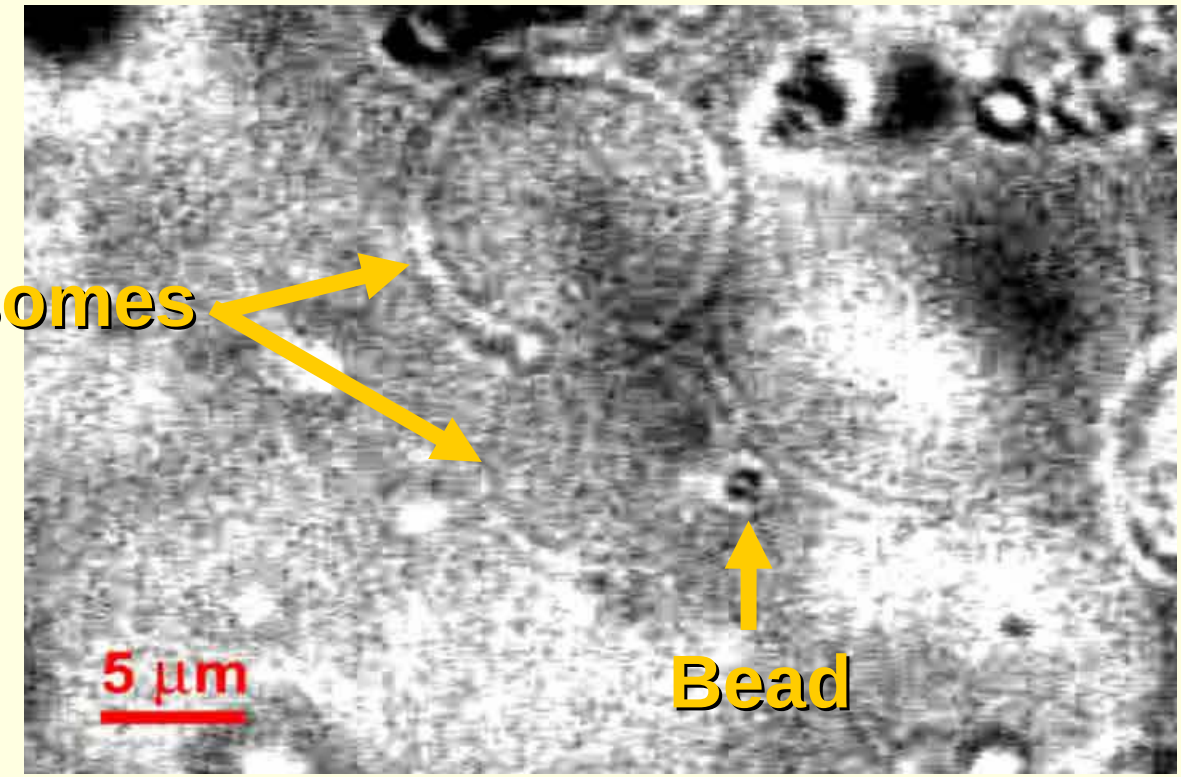


E. Coli provacuoles fusion with bulk electrodes

Membranes must be **soft** and **fluid** enough

Towards Transfer of Microstructure

Microstructure delivery by vesicle-vesicle electrofusion



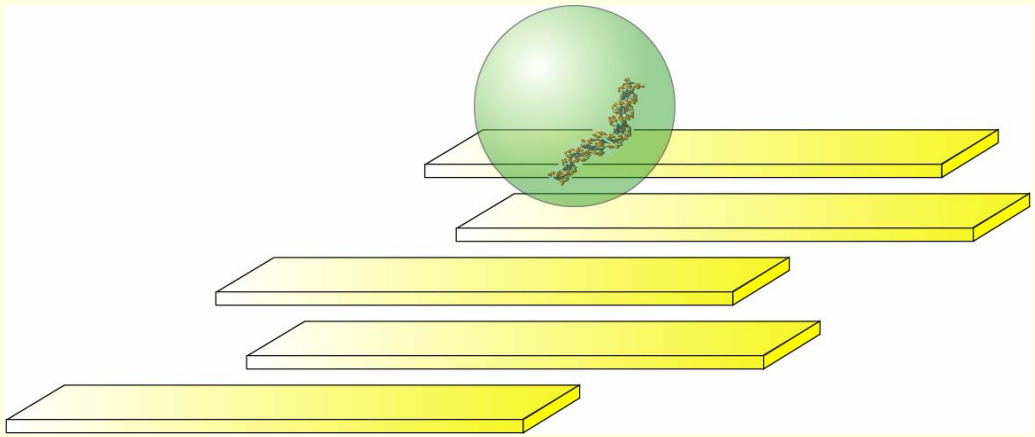
0.32 µm microbeads transfer into liposome

Conclusions

- A **microfluidic device** for electrofusion of liposomes at **low power level** has been designed and tested. Fusion yield can reach **75 %**,
- Possibility to fuse cells but the membrane must be **soft** and **fluid** to obtain good fusion yield,
- Possibility to **deliver microstructures** into liposomes.

Prospects

- **Cell labeling** for biomedical applications
- **Drug** and **gene** delivery
- **Single molecule** and **femtoliter drug** manipulation



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