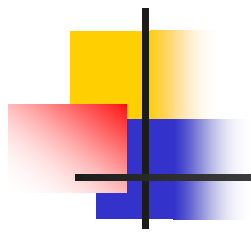




Mikrofluidika – na poti do nanotehnologije

Dušan Babić

Oddelek za fiziko, FMF, Univerza v Ljubljani

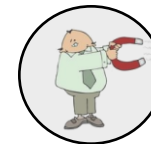


- Kaj je mikrofluidika?

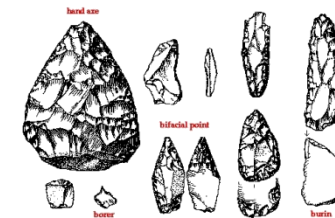


1/makrofluidika

- Kaj so magnetni koloidi?



- Eksperimentalna orodja:



- Nekaj rezultatov:



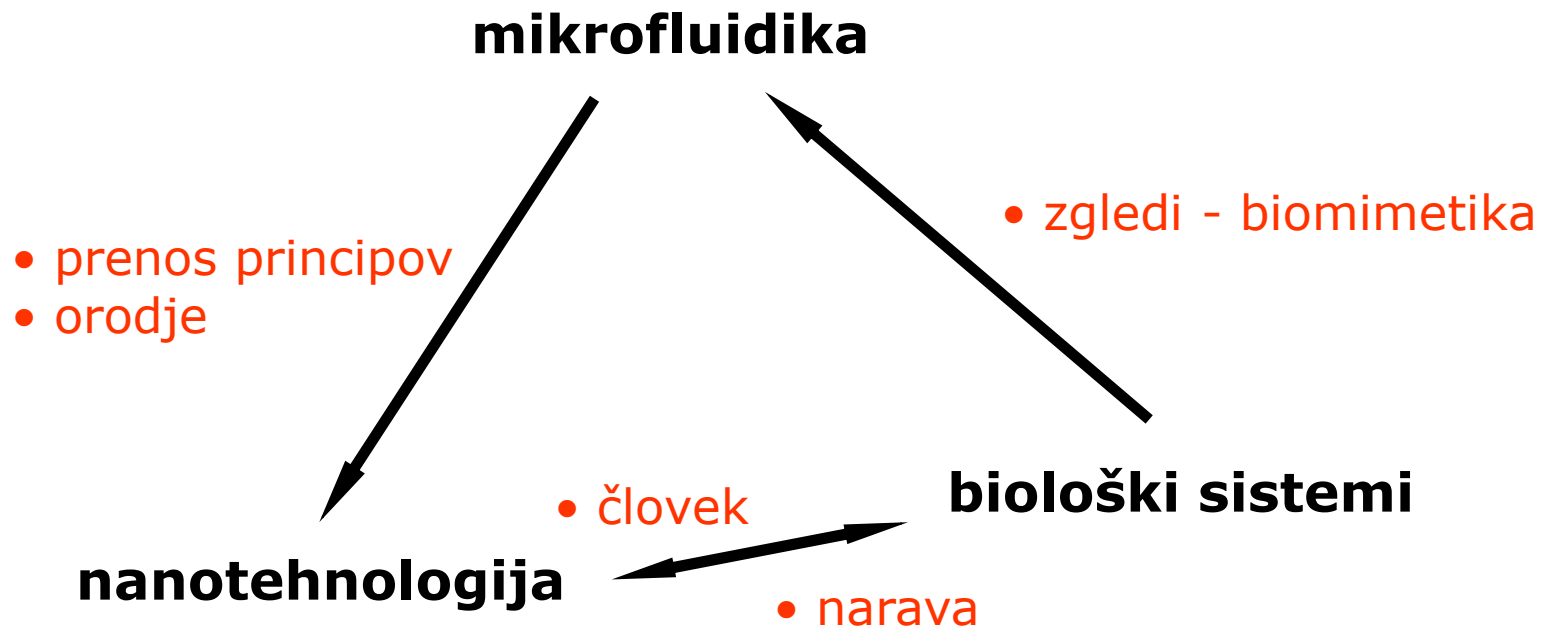


Mikrofluidika

- manipulacija majhnih količin tekočin (nl do al)
- uporaba: analitične metode, senzorji, mikroreaktorji, avtomatizirani presejalnih testi ...
- prednosti: manjši stroški, manjše količine potrebnih materialov, manj odpadnih produktov, večja hitrost reakcij, višja stopnja avtomatizacije ...
- "sveti gral" mikrofluidike: Lab-on-a-chip

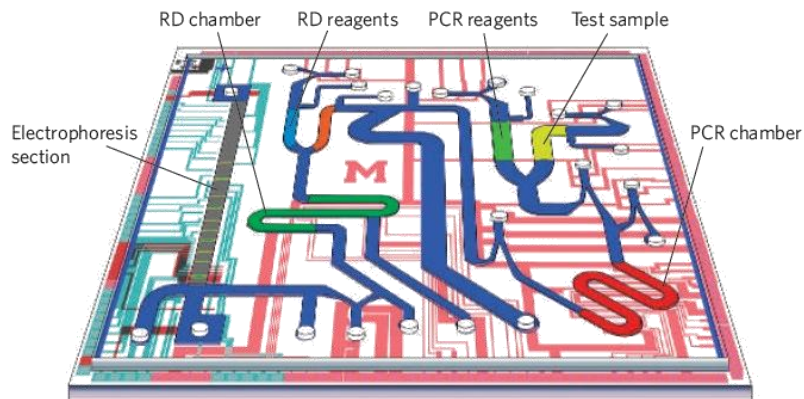


Mikrofluidika in nanotehnologija

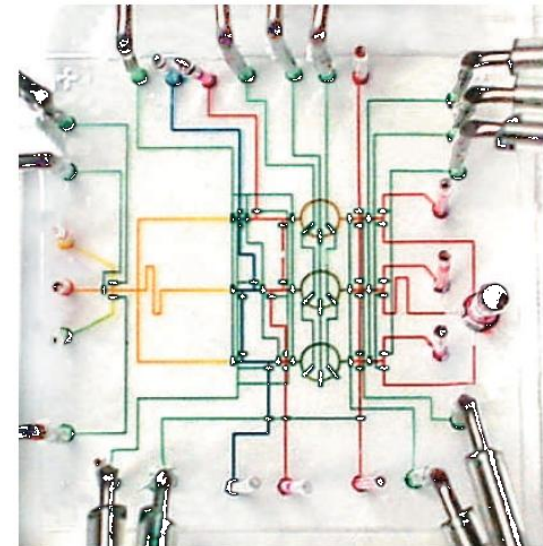


Lab-on-a-chip

- **pasivne komponente** – kanali, komore, topografske strukture ...
- **aktivne komponente** – ventili, črpalke, senzorji ...



Jamil El-Ali et al. *Nature*, **442**, 2006



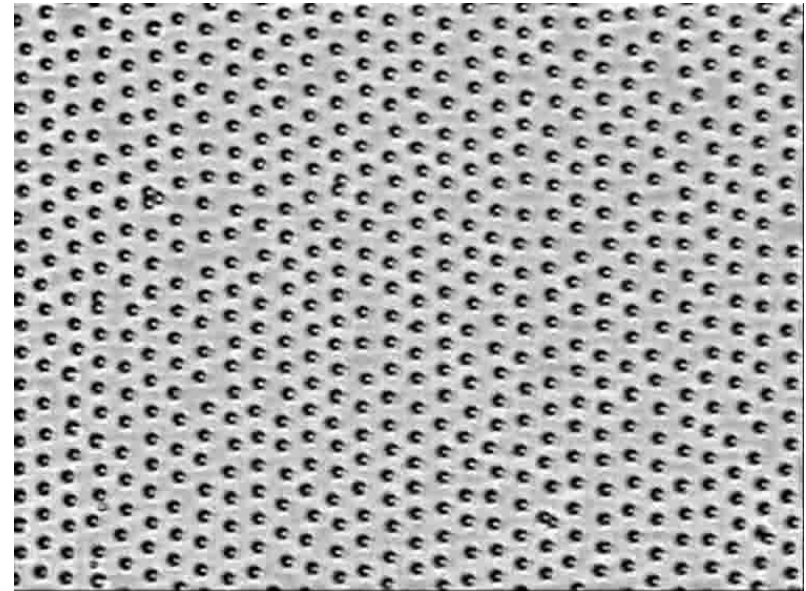


Eksperimentalna orodja

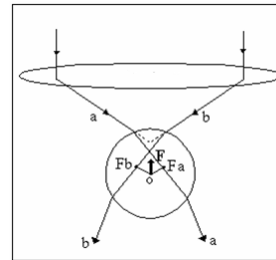
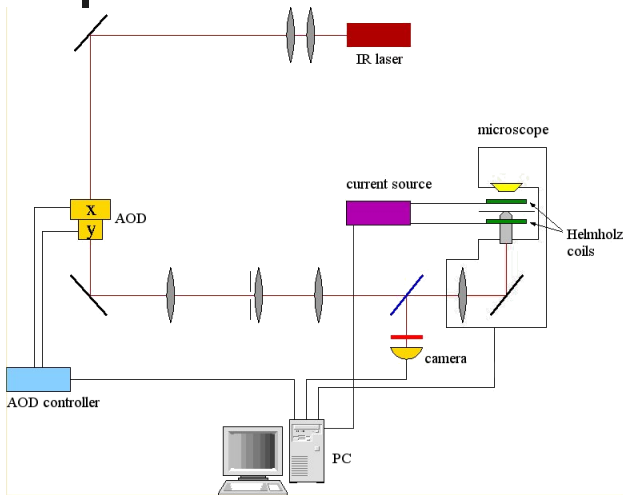
- koloidi (gradniki),
- video mikroskopija (opazovanje, karakterizacija),
- laserska pinceta (manipulacija posamičnih koloidov),
- magnetna pinceta (uravnavanje meddelčne interakcije),
- litografija (mikro strukture)

Koloidi

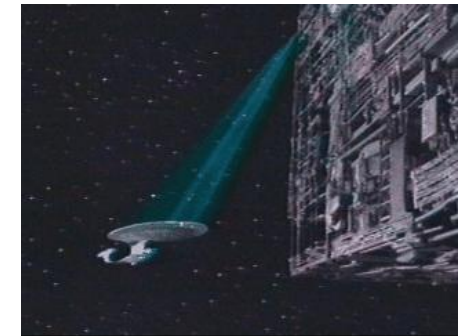
- koloidi – kroglice,
 - znane interakcije,
 - monodisperzni,
 - μm velikosti,...
-
- enostavno opazovanje,
 - enostavna manipulacija,
 - dobro določene lastnosti,...



Laserska pinceta

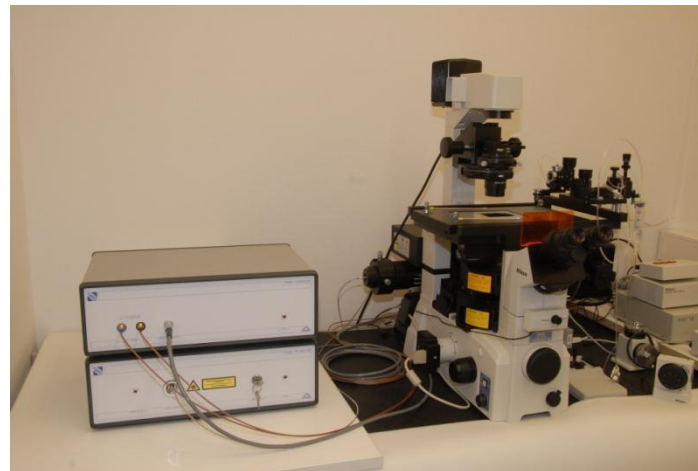


Laserska pinceta - princip



Laserska pinceta za reveže

Eksperimentalna postavitve



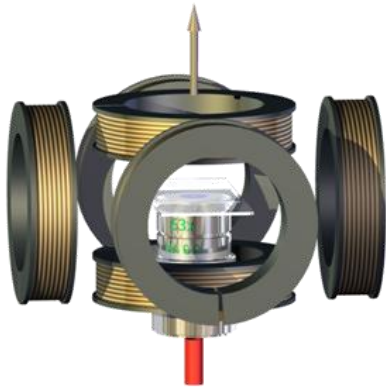
Aresis d.o.o.

V laboratoriju...

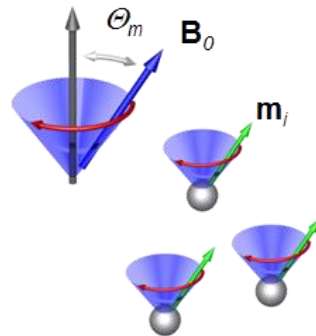
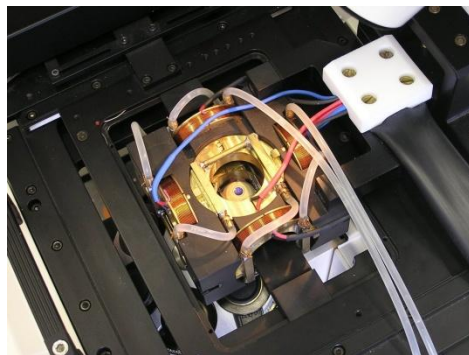
... v živo!



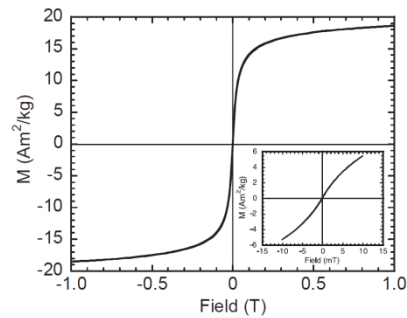
Magnetna pinceta in magnetni koloidi



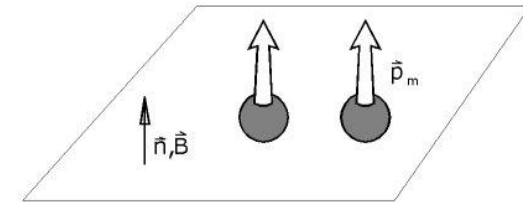
Magnetna pinceta - postavitev



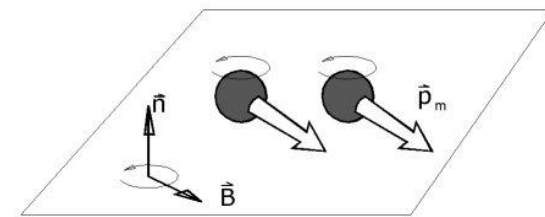
Magnetni koloidi



Dynabeads 1 μm MyOne



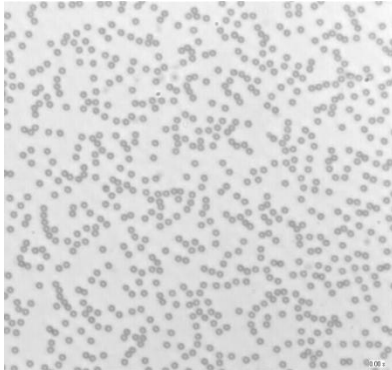
Odbojna interakcija (izotropna - 2d)



Privlačna interakcija (izotropna - 2d)

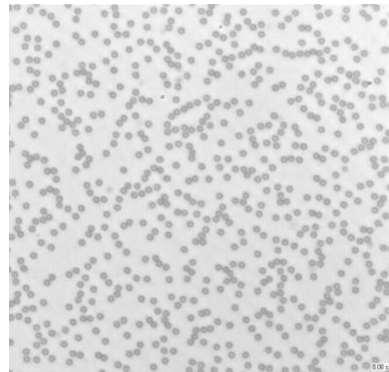
Magnetna pinceta in magnetni koloidi – primeri

Statično polje – v ravnini vzorca



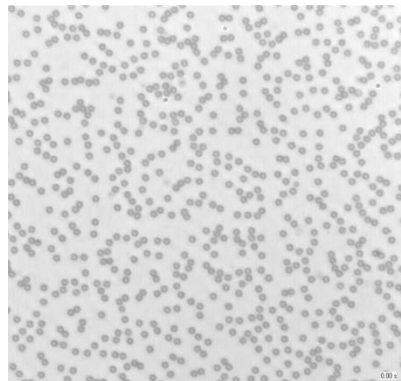
I.

Vrteče polje (enosmerno) – v ravnini vzorca

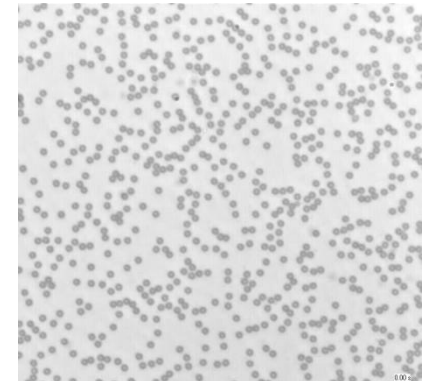


III.

II.



IV.



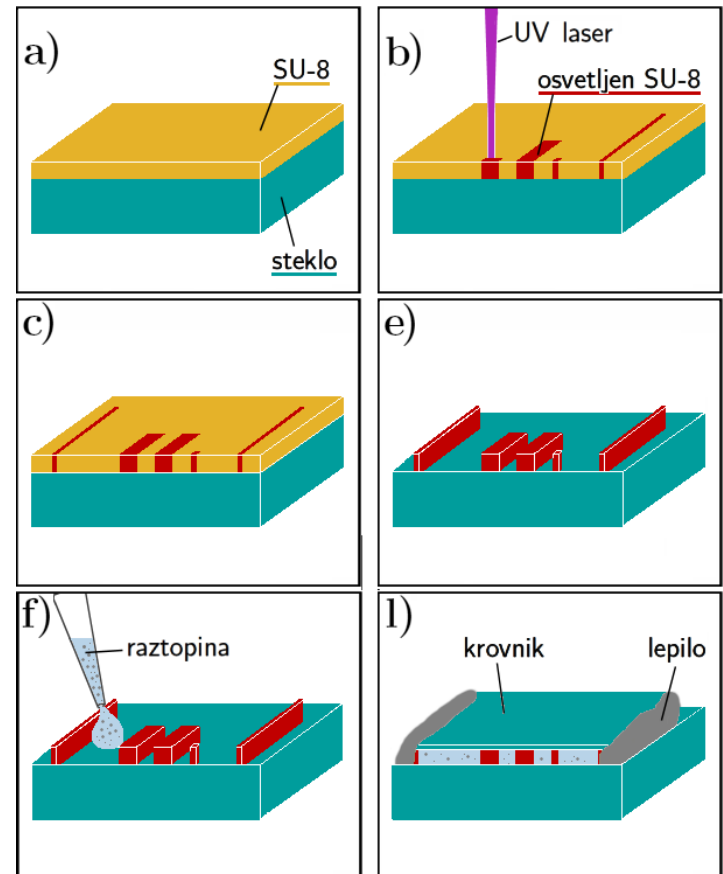
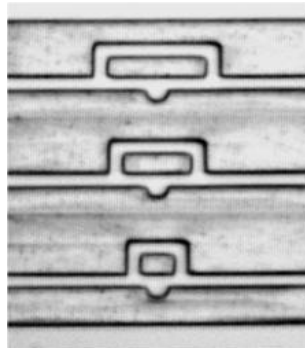
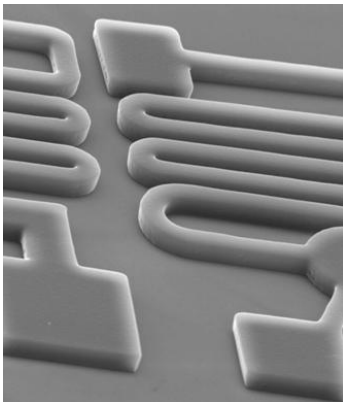
Vrteče polje (izmenično) – v ravnini vzorca

Statično polje – pravokotno na ravnino vzorca

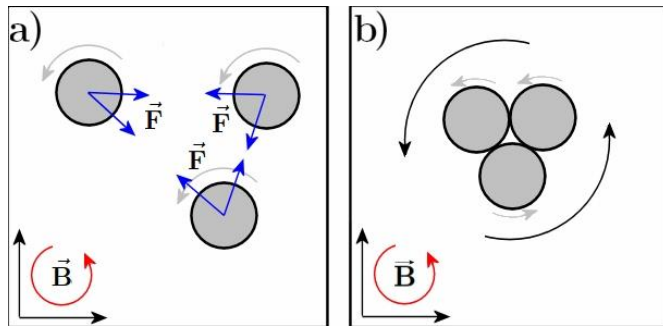


Litografija – primer izdelave vezja

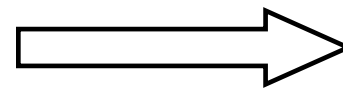
- Nanos tankega sloja fotorezista na substrat,
- Osvetlitev sloja z vzorcem strukture,
- Termična obdelava,
- Razvijanje,
- Polnjenje s koloidno raztopino,
- Zatesnitev mikrofluidičnega vezja.



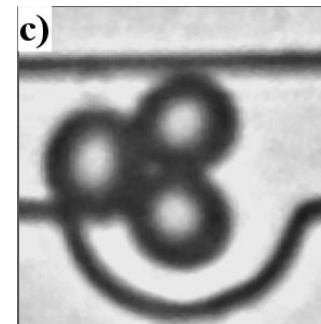
Enostavne črpalke (III.)



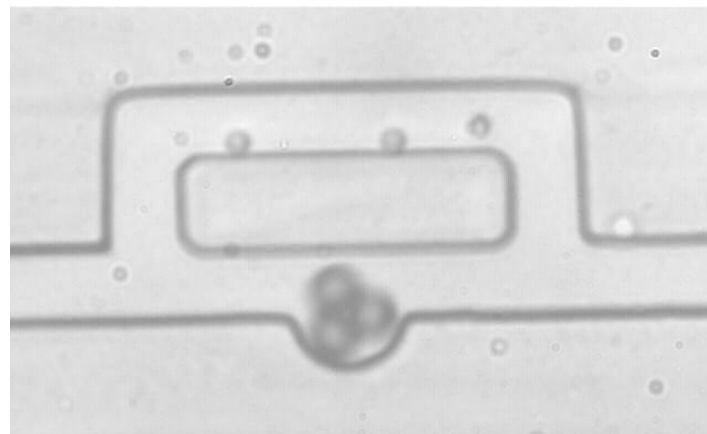
Samosestavljeni rotor črpalke



V mikrofluidični kanal

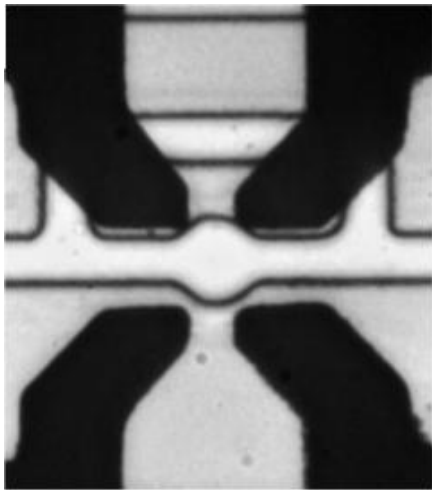


Črpalka

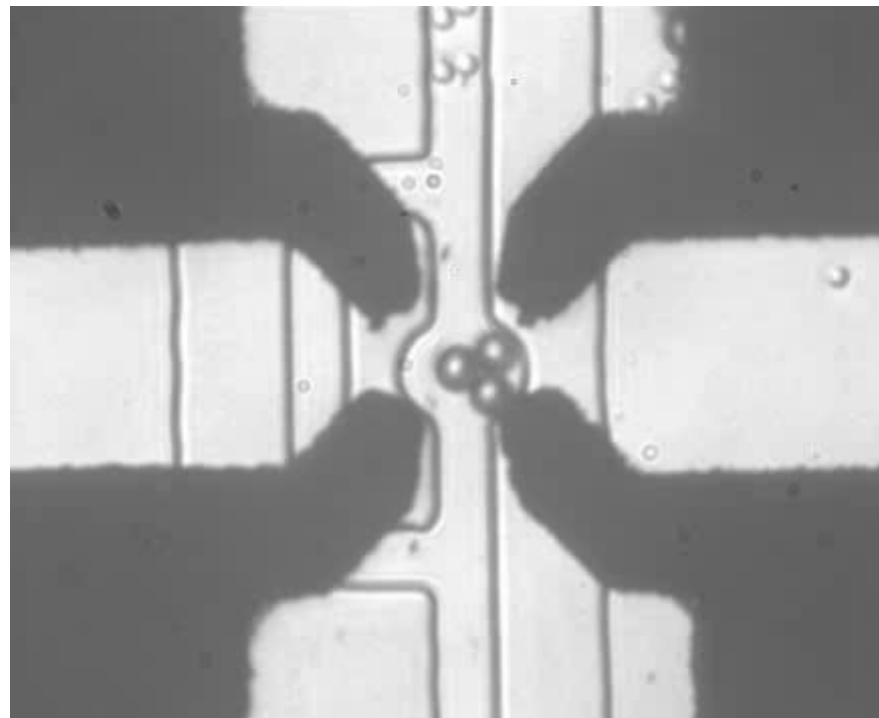


Delovanje

Manj enostavne črpalke



Kontrola rotorja črpalke z dielektroforetsko silo oz. navorom



Kontrola smeri toka

Kavčič B. et al., *Appl. Phys. Lett.*, **95**, 2009

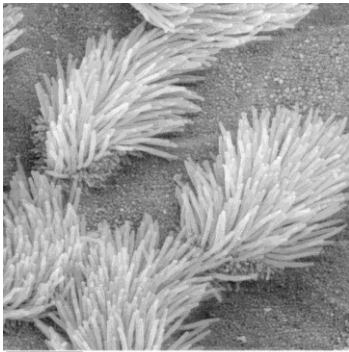
Windows

A fatal exception 0E has occurred at 0137:BFFA21C9. The current application will be terminated.

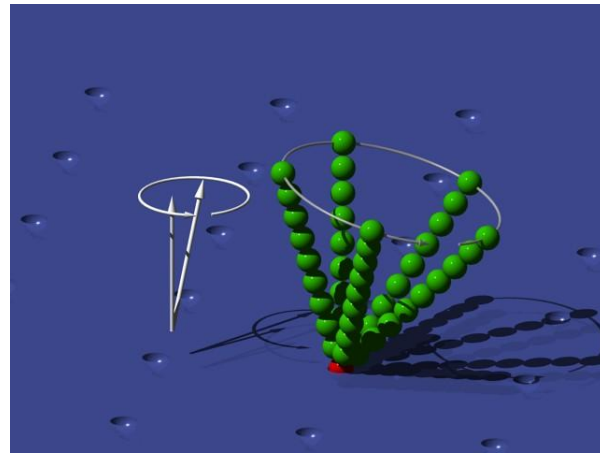
- * Press any key to terminate the current application.
- * Press CTRL+ALT+DEL again to restart your computer. You will lose any unsaved information in all applications.

Press any key to continue _

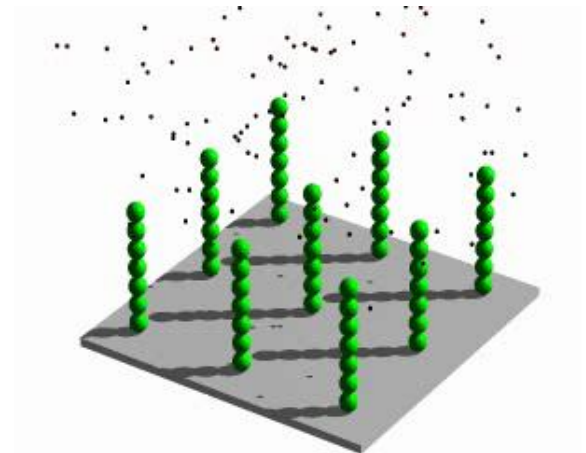
Migetalka – biomimetični sistem (I.)



Sluznica



Umetna migetalka – pritrjena veriga magnetnih koloidov



Polje migetalk

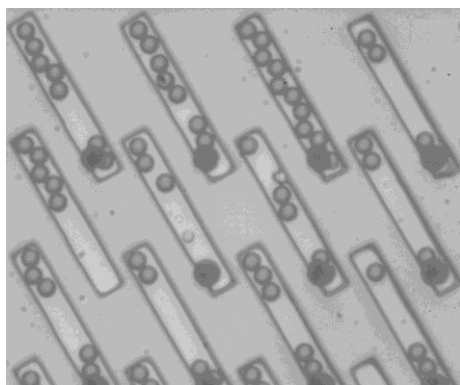
Simulacija – A. Vilfan, IJS

Migetalk – delovanje

Polje migetalk – "ročno" sestavljanje



Polje migetalk – meritve toka tekočine

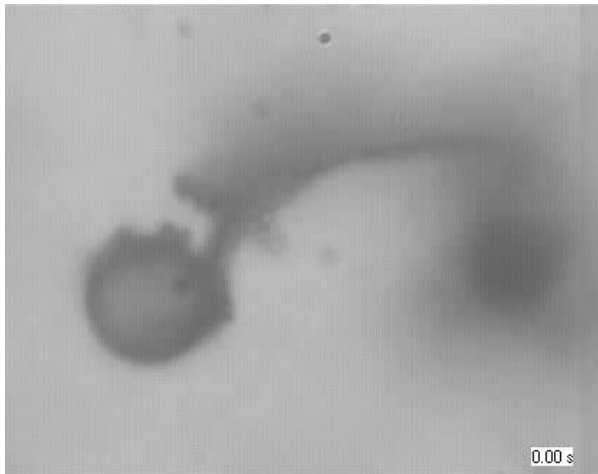


Polje migetalk – samosestavljanje

Vilfan M. et al., *PNAS*, **107**, 1844 (2010)
Nature Physics, News and Views, Jan. 2010

Koloidne membrane – biomimetični sistem (IV.)

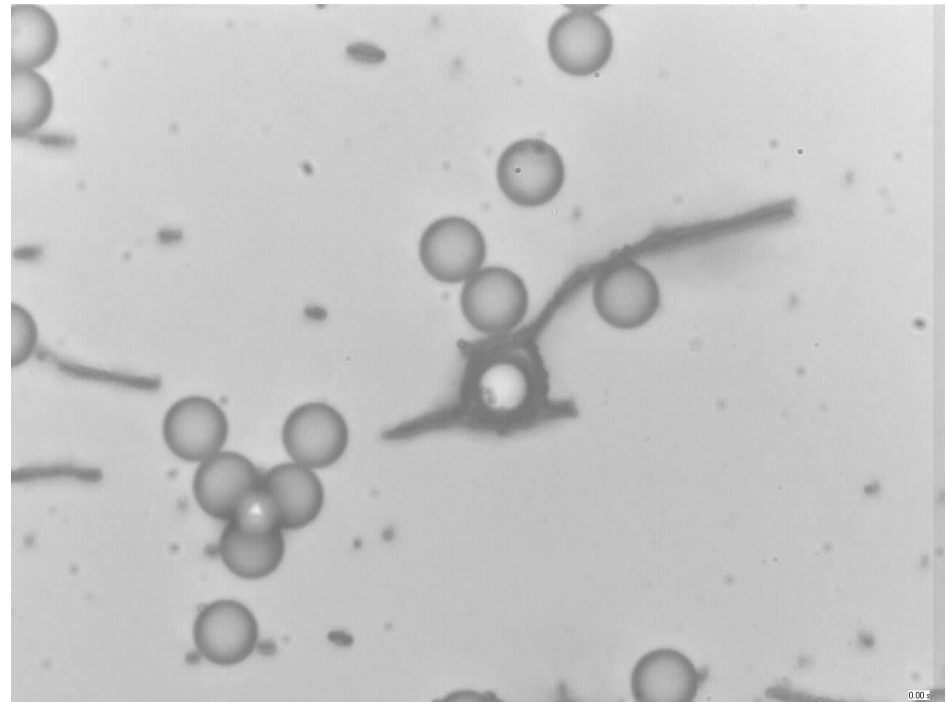
Osterman M. et al., *PRL*, **103**, 228301-1 (2009)
Nature, News and Views, Jan. 2010



Pripeta koloidna membrana



Razkroj koloidne membrane



Prehod skozi koloidno membrano

Laboratorij za eksperimentalno mehko snov, FMF

Igor Poberaj, FMF/Aresis

Natan Osterman, FMF/IJS

Blaž Kavčič, FMF/LPKF

Anton Potočnik, FMF/IJS

Mojca Vilfan, IJS

Andrej Vilfan, IJS

Gašper Kokot, FMF/IJS

