Micro- and Nano-Flows: Challenges in Fluid Mechanics

part 2

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List of Proposals

Ideas

- Thermal And Viscous Transport Effects in Nanofluids(TAVTEN)
- Non-equilibrium Effects Micro- And Nanofluidics (NEMAN)
- Electrospinning of nanofibers optimization (ELSPINOPT)

Cooperation

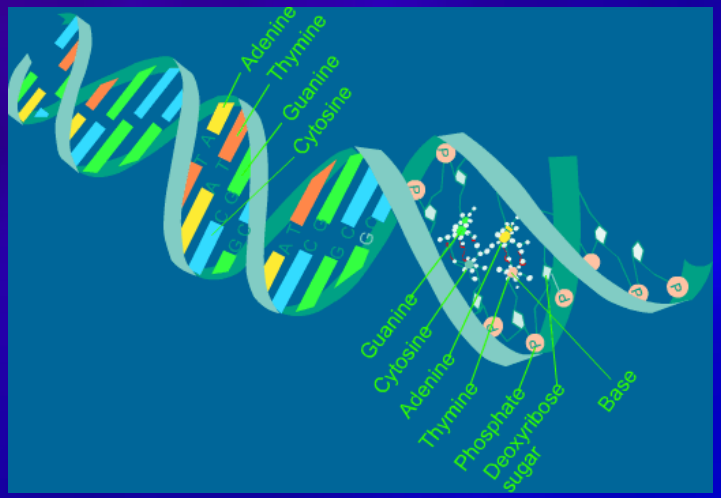
- Flow Efficient DNA Amplifier (FEDA)
- Mesoscopic modeling Applied to Cell manipulation; Lab-On-Chip design (MACLOC)
- Drug delivery system based on nanofibers and polymers membranes: production modelling and application (DDSNANOFIB)

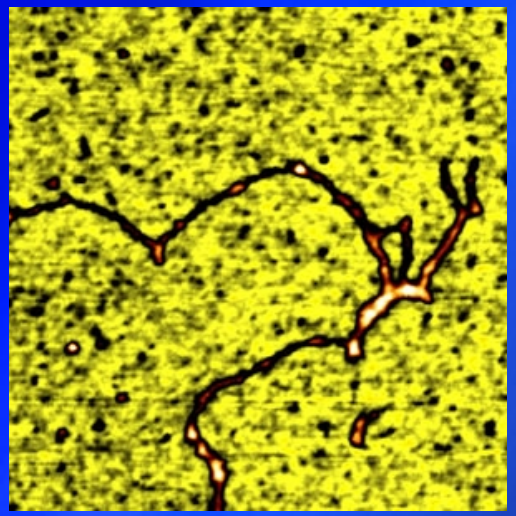
Center of Excellence

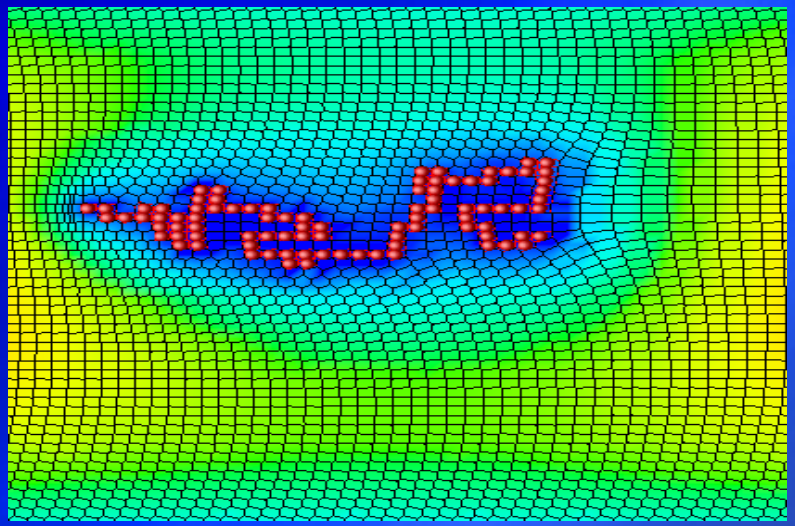
- NANOfluids: Simulations, Experiment and Theory (NANOSET)

FEDA - *Flow Efficient DNA Amplifier* (COOPERATION)

Motivation Cheap (currently about 2500USD) and more efficient (currently ~ 11h) DNA multiplication tool







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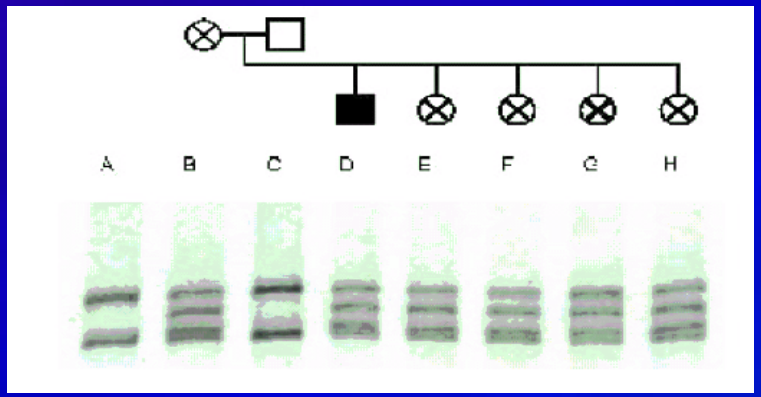
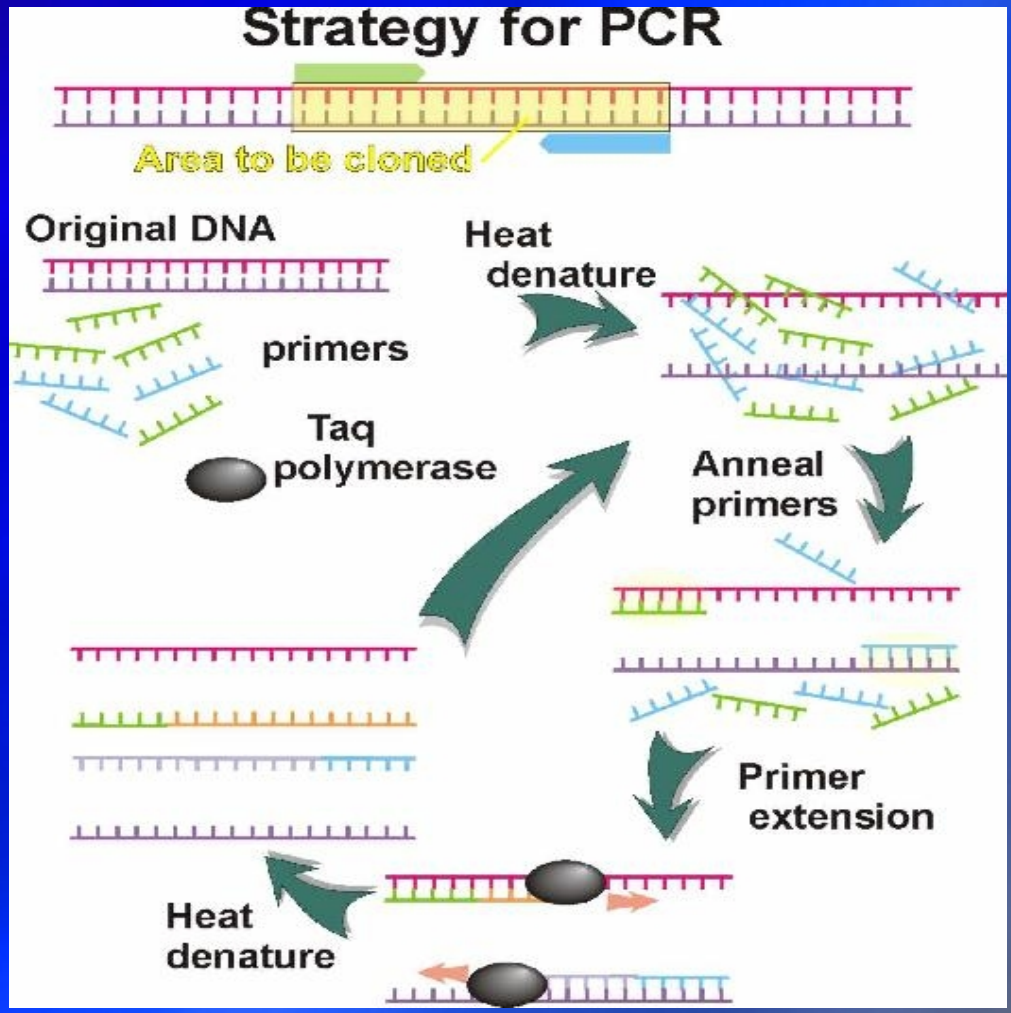
FEDA - *Flow Efficient DNA Amplifier* (COOPERATION)



Polymerase chain reaction enzymatically replifying DNA



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techniki elektroforetyczne

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FEDA - *Flow Efficient DNA Amplifier* (COOPERATION)

AIM

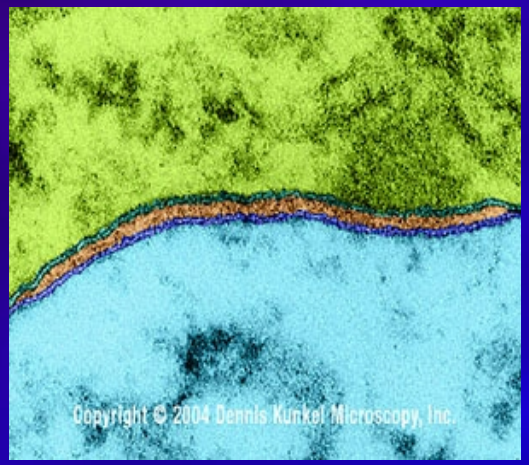
- Models and experimental investigation of the flow structures to increase every step of PCR process
- Obtain efficient (time and cost) DNA amplifier.

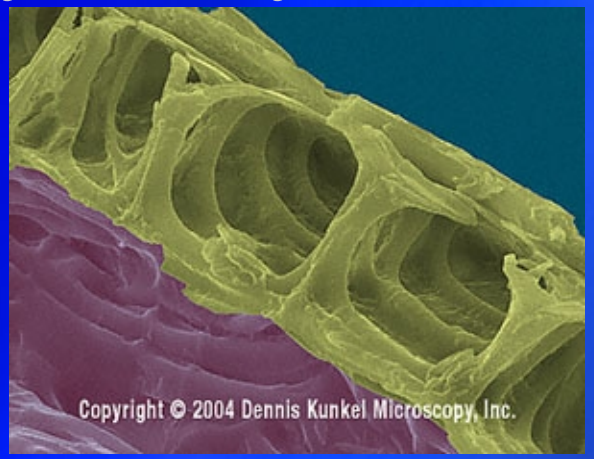
COOPERATION PARTNERS

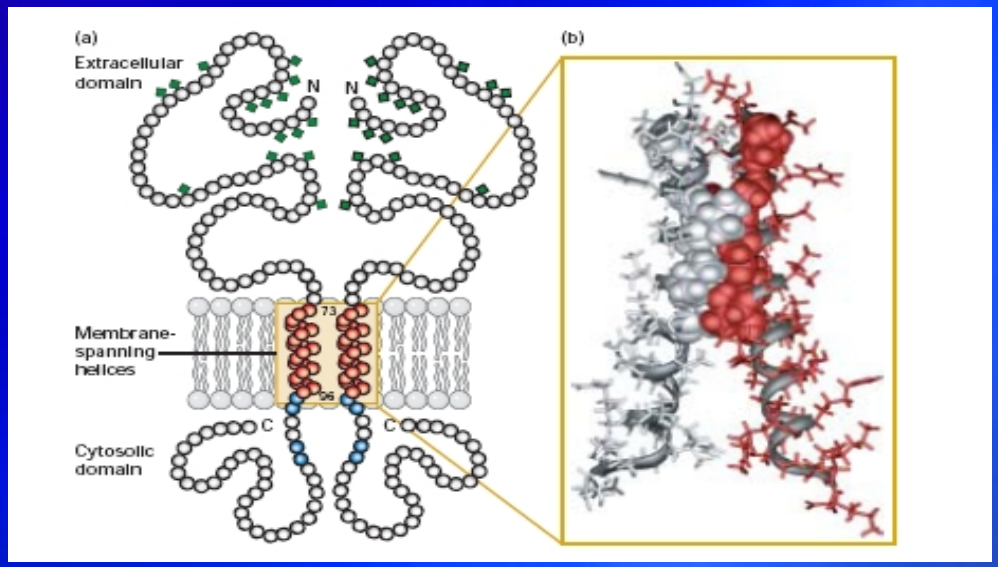
- KTH Stockholm, Sweden
- U. Strathclyde, UK
- U. Limerick, Ireland
- LIMSI Paris, France
- ESPCI Paris, France
- Erlangen University, Germany
- Dortmund University, Germany
- Institute of Physical Chemistry PAN, Warsaw, Poland

DDSNANOFIB - Drug delivery systems based on nanofibers and polymer membranes: production, modeling and application (COOPERATION)

Motivation New type of Drug Delivery Directly to the Cell





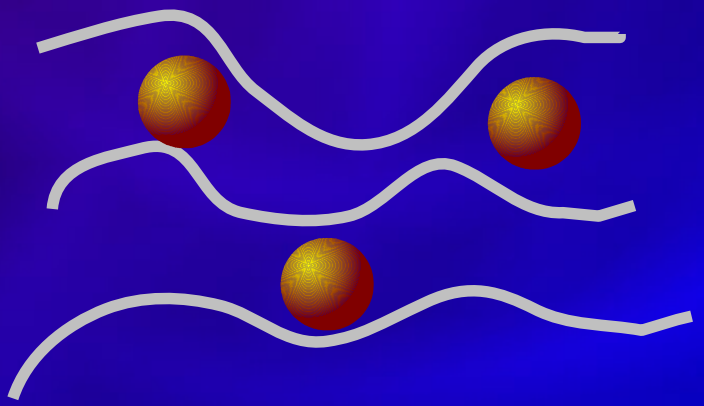


Mesoscale Description

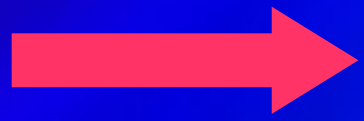
Molecular Description

DDSNANOFIB - Drug delivery systems based on nanofibers and polymer membranes: production, modeling and application (COOPERATION)

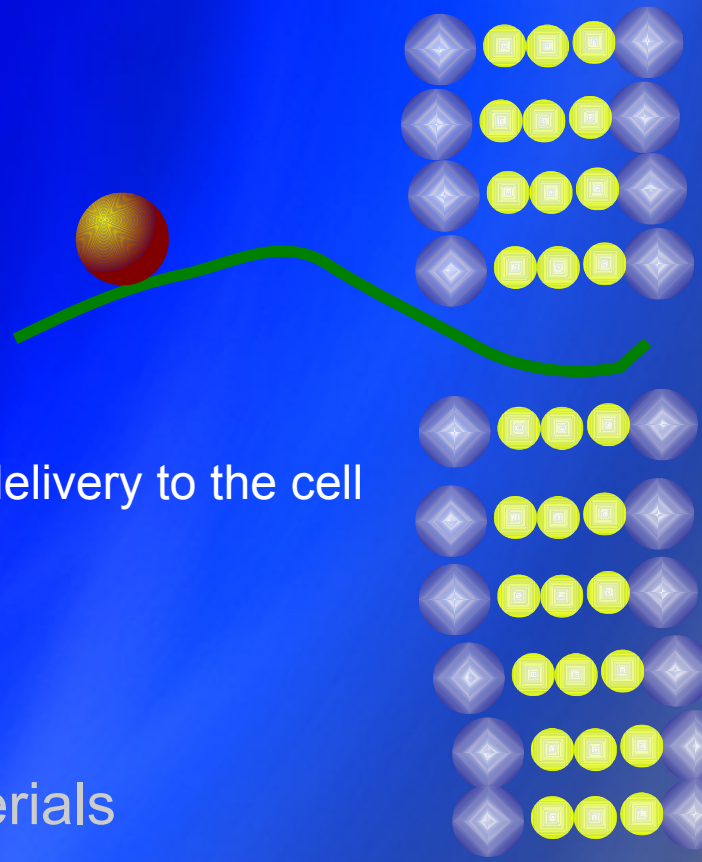
Nanofibers material with drug particles



Drug embedded in nanofibers



Cell membrane



Drug delivery to the cell

Steps to investigate

- Production of biodegradable nanofibers materials
- Drug diffusion processes (material - cell)

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DDSNANOFIB - Drug delivery systems based on nanofibers and polymer membranes: production, modeling and application (COOPERATION)

AIM

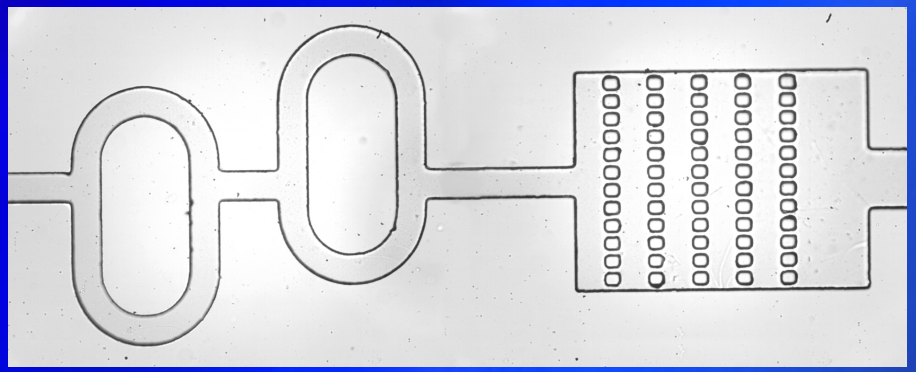
- Controlled and efficient drug delivery system
- Production of biodegradable materials for internal and external wound dressing
- Study of efficiency of drug diffusion processes

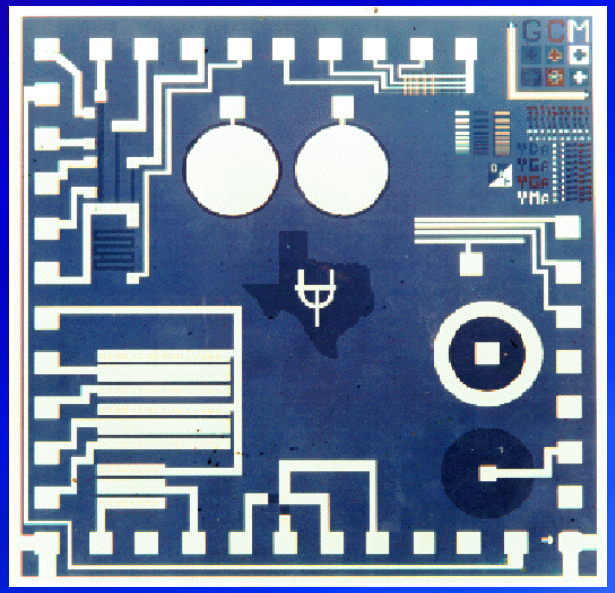
COOPERATION PARTNERS

- Warsaw Institute of Technology, Poland
- Warsaw Medical University, Poland
- Textile Institute Łódź, Poland
- Technion, Haifa, Israel
- U. Illinois, Chicago, USA
- Technical University Łódź, Poland

MACLOC - Mesoscopic modelling Applied to Cell manipulation; Lab-On-Chip design (IDEA)

Motivation Efficient and Integrated tool to bio-medical analysis





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MACLOC - *Mesoscopic modelling Applied to Cell manipulation; Lab-On-Chip design* (IDEA)

AIM

- Improve efficiency of the design of lab-on-chip by enhancement of numerical models
- Mesoscale simulations and experiments building models and designing lab-on-chip for various applications
- Artificial cell : fluid- electrical control interaction

COOPERATION PARTNERS

- Oxford University, UK
- IAC, Rome, Italy
- TU Dortmund, Germany
- LIMSI, Paris, France
- KTH, Stockholm, Sweden
- Erlangen University, Germany
- Harvard University, USA
- Stanford University, USA
- VCU, Richmond, USA

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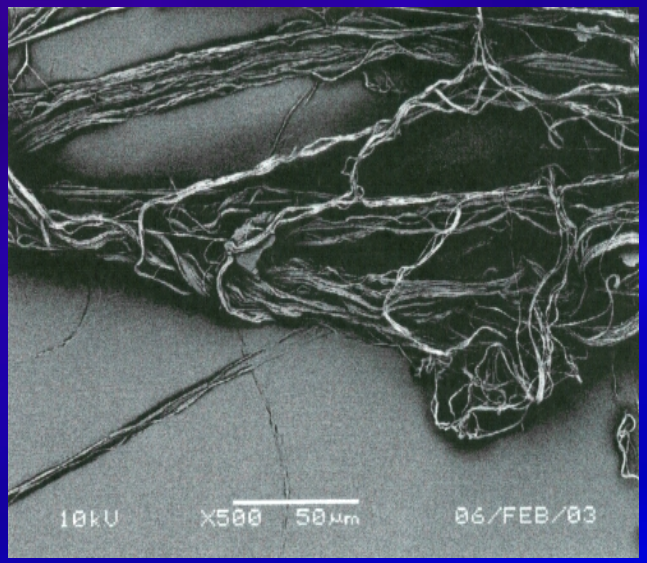
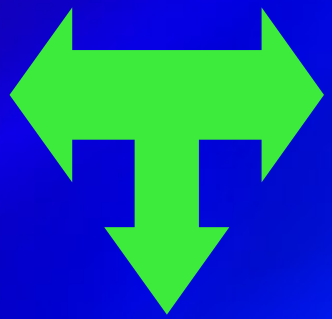
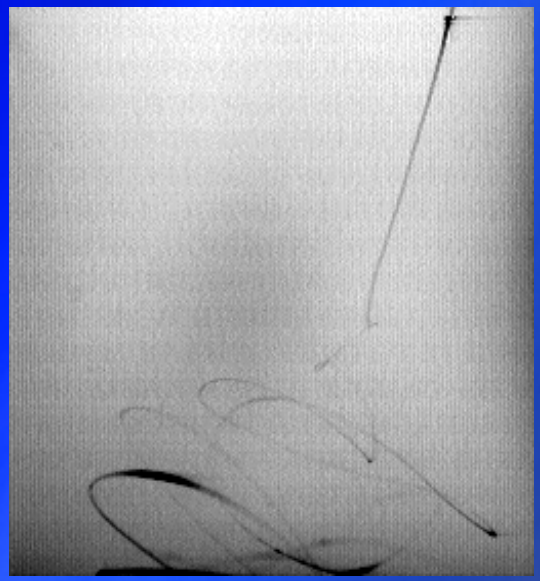
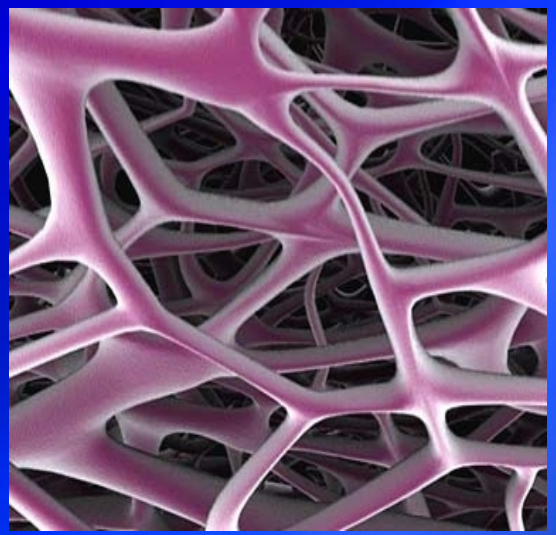
ELSPINOPT - *Electrospinning of nanofibers* (IDEAS)

Motivation Optimization of electrospinning process to obtain desired nanofibers









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ELSPINOPT *- Electrospinning of nanofibers* (IDEAS)

AIM

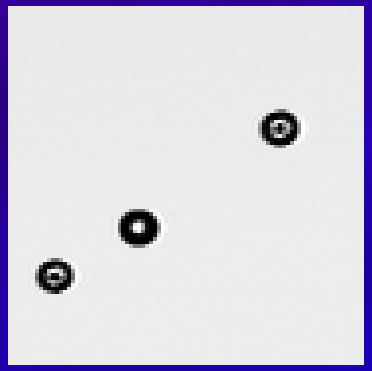
- Optimization of electrospinning process (voltage, polymer concentration)
- Production of 'smart materials', biodegradable materials, tissue engineering

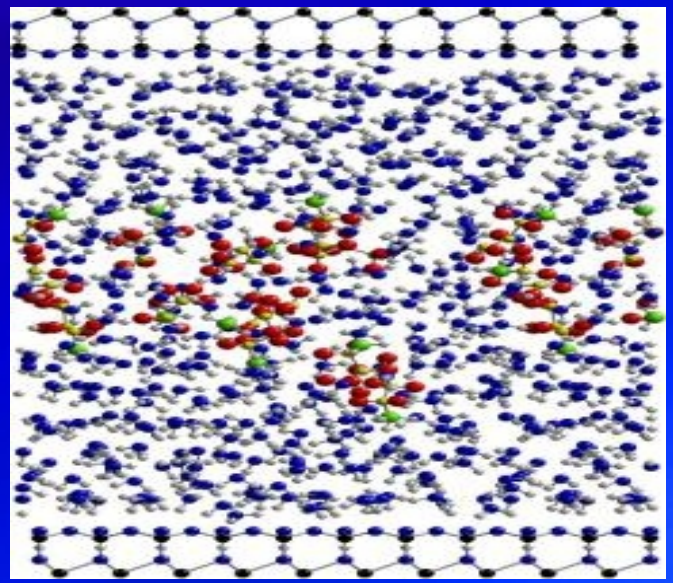
COOPERATION PARTNERS

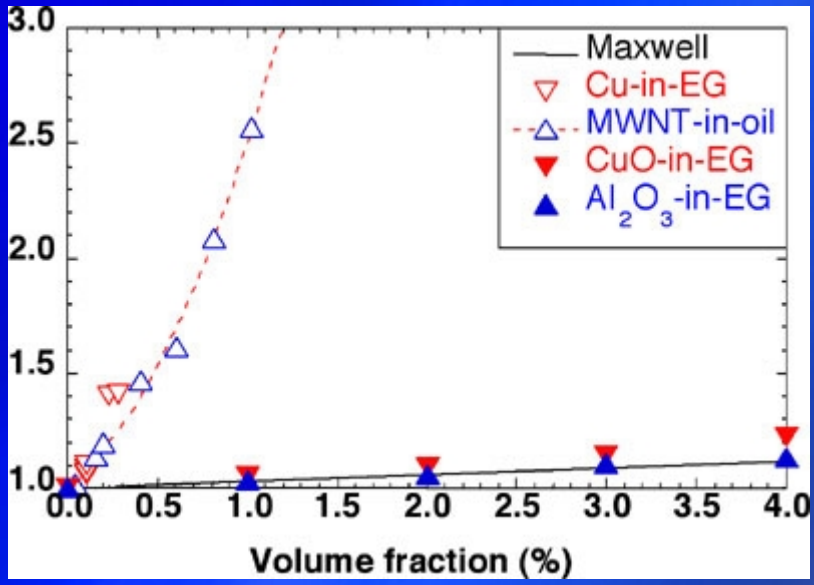
- Textile Institute Łódź, Poland
- Imperial College London, UK
- Technion, Haifa, Israel
- U. Illinois, Chicago, USA
- Technical University Warsaw, Poland
- Technical University Łódź, Poland
- Donaldson Inc., USA

TAVTEN - *Thermal And Viscous Transport Effects in Nanofluids* (COOPERATION)

Motivation dilute suspension of nanoparticles drastically changes global behavior of fluid







Thermal conductivity enhancement of copper, copper oxide, and alumina particles in ethylene glycol (EG); multiwalled nanotubes (MWNT) in oil and predicted by Maxwell's theory

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TAVTEN - Thermal And Viscous Transport Effects in Nanofluids (COOPERATION)

AIM

- Simulation: mesoscopic particle simulation of nanofluids transport coefficients;
- Molecular study of the fluid-solid (nanoparticle -fluid) interaction to control clustering of nanoparticle and sedimentation processes.
- Molecular study of wall-particle interaction to prevent clustering of particles near walls
- Experimental: study of the influence of the nanoparticle concentration on the nanofluid properties;

COOPERATION PARTNERS

- Harvard University, USA
- MIT, USA
- Los Alamos NL, USA
- Yale University, USA
- Institute of Fluid Flow Machinery PAN, Gdansk, Poland

NEMAN - *Non-equilibrium Effects Micro- And Nanofluidics* (IDEAS)

Motivation surface to volume effects dominance; need for accurate and efficient prediction of solid-fluid interaction

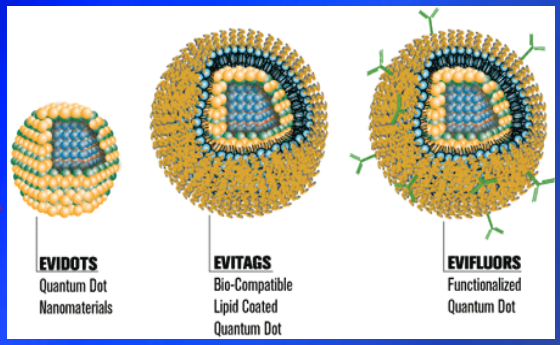
gravity

Macro-scale

surface tension

Micro-scale

quantum dot



Nano-scale

length	surface	volume
1m	$1m^2$	$1m^3$
1μm 10^{-6} m	$1\mu m^2$ 10^{-12} m	$1\mu m^3$ 10^{-18} m
S^1	S^2	S^3

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NEMAN - Non-equilibrium Effects Micro- And Nanofluidics (IDEAS)

AIM

- Mesoscopic models of Fluid-Solid Interaction, theoretical, numerical and experimental validation
- Fast numerical mesoscale algorithms for computation of complex engineering micro- and nano- scale flows

COOPERATION PARTNERS

- Oxford University, UK
- IAC in Rome, Italy
- Harvard University, USA
- VCU, Richmond, USA
- Technical University, Gdansk, Poland
- MIT, USA

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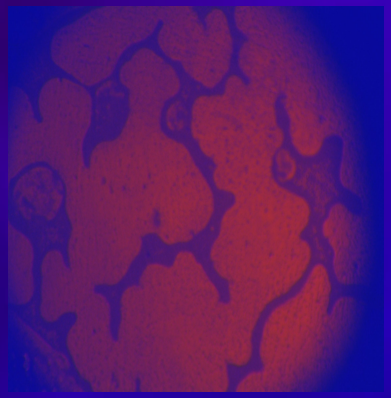
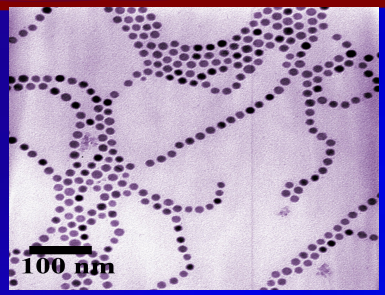
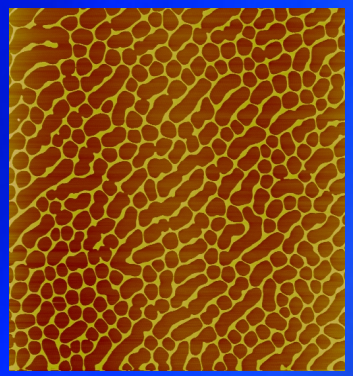
NANOSET - *NANOfluids: Simulations, Experiment and Theory* (CENTER OF EXELENCE)

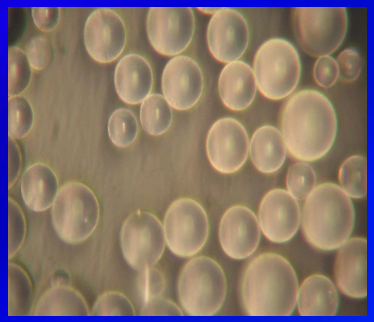


van der Waals self-organization

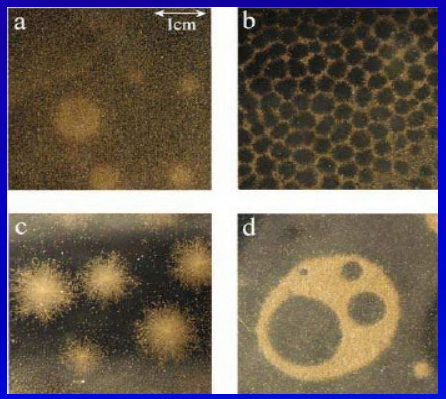




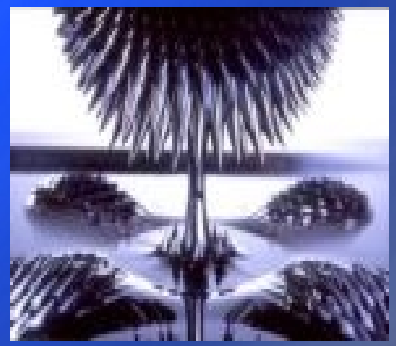
sedimentation pattern



surface tension self-organization



electrofluids



ferrofluids

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NANOSET - *NANOfluids: Simulations, Experiment and Theory* (CENTER OF EXCELLENCE)

AIM

- Collaboration, workshops, experience exchange and conferences in topics of nanofluids

COOPERATION PARTNERS

- LIMSI, Paris, France
- Oxford University, UK
- IAC, Rome, Italy
- Tel-Aviv University, Israel
- KTH, Stockholm, Sweden
- Erlangen University, Germany
- Harvard University, USA
- MIT, USA
- National Nanotechnology Infrastructure Network, USA
- Stanford University, USA
- Los Alamos NL, USA
- Yale University, USA
- VCU, Richmond, USA
- Institute of Physical Chemistry PAN, Warsaw, Poland
- Institute of Fluid Flow Machinery PAN, Gdansk, Poland

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Current funding possibilities

- ERA-NET: small (up to 5) collaboration partners 28.9M€ deadline 31.7.2007
- COOPERATION: NMP 105.723 M€ deadline 4.05.2007
  (possibilities Nano-scale mechanismof bio/non-bio interaction; self-assembling and self-organization; nanostructure coating and thin films)
- COOPERATION with SME 44M€ deadline 4.05.2007
  (Application of new materials including bio-based fibres in high-added value textile products)
- COOPERATION HEALTH 28.9M€ deadline 31.7.2007
  (Nanosicence and converging science 0M€- 2007)
- COOPERATION NMP Large 15M€ Deadline 5.07.2007
  (Examining capacity building in nanobiotechnology)
- COOPERATION ICT 1019M€ Deadline 8.05.2007
  (Personal health systems for monitoring and point of care diagnostics)
- PEOPLE 9.5M€ deadline 26.04.2007 (Marie Curie Awards)

THANK YOU FOR ATTENTION

AND

WELCOME TO DISSCUSSION