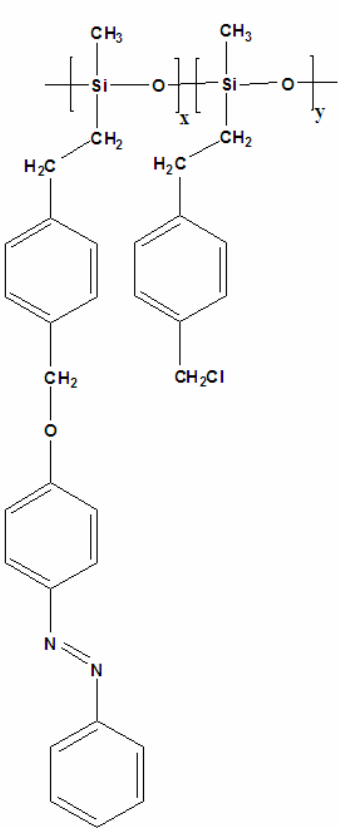
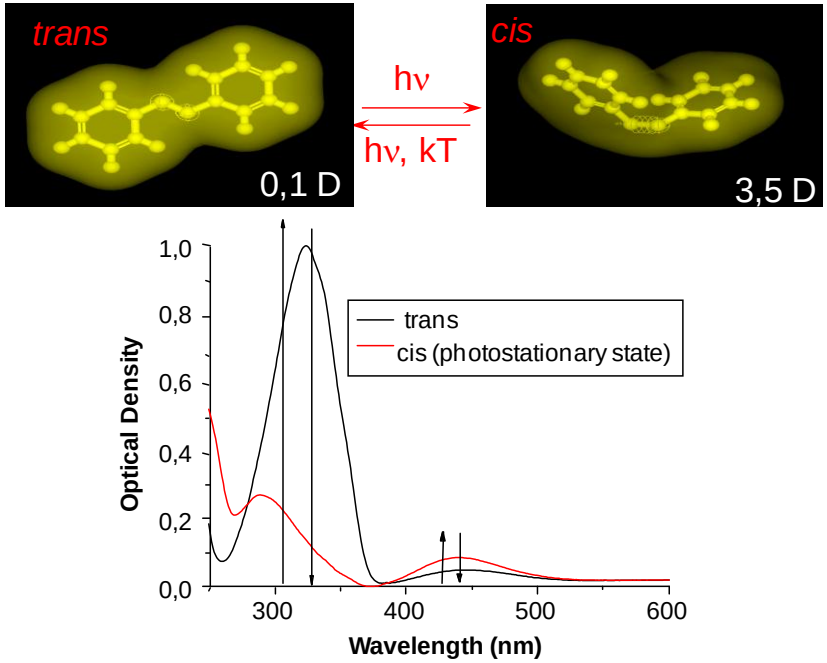
BIOAZO
Photosensitive azo-polymers for biological applications

CEA-IFA bilateral cooperation

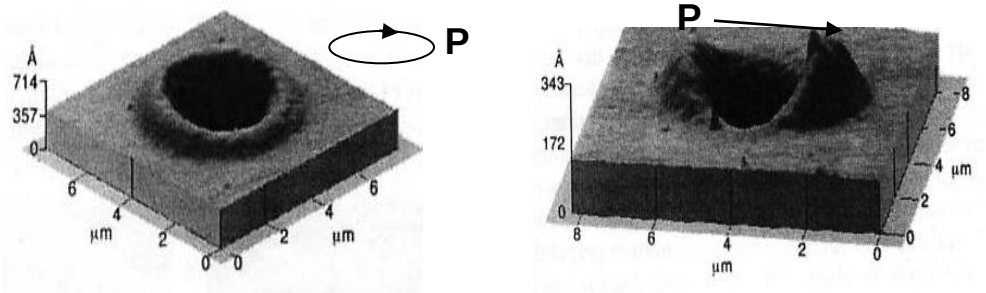
IFA, Bucaresti, 17-18 October 2012

WHY AZO-POLYMERS ?



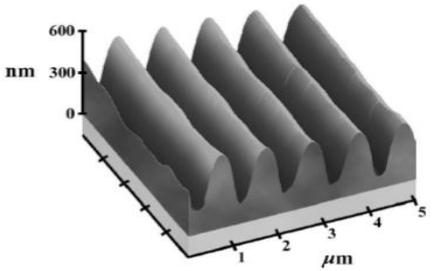


N. K. Viswanathan et al, J.Mater. Chem., 9, 1941 (1999)



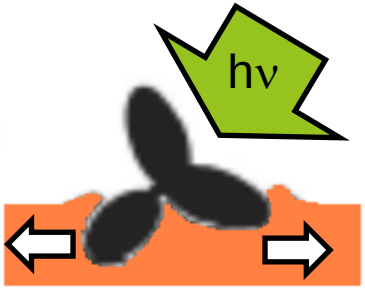
APPLICATIONS

- Biological cell growth supports



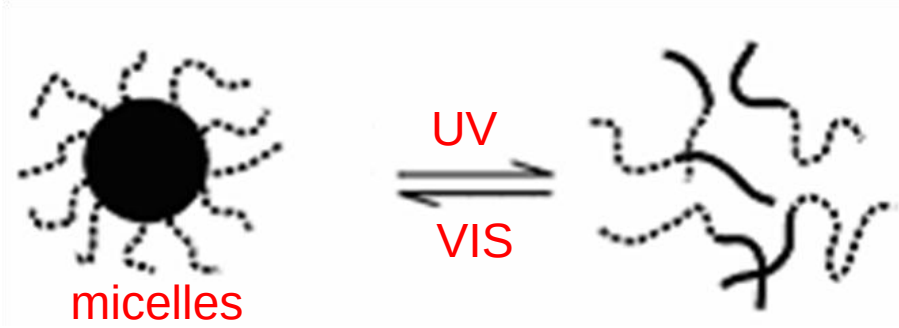
Thin polymer films

- Immobilization and nano manipulation



Liquid media

- Drug delivery



TASKS DISTRIBUTION

Need of a multidisciplinary team

- The "Gheorghe Asachi" Technical University of Iasi (UTIasi) – Pr Nicolae HURDUC
  - Polymers Synthesis and characterization
  - Micellar organization
  - Molecular modeling

- National Institute for Laser, Plasma and Radiation Physics, Bucharest – Dr Victor DAMIAN
  - Pulsed laser films nanopatterning

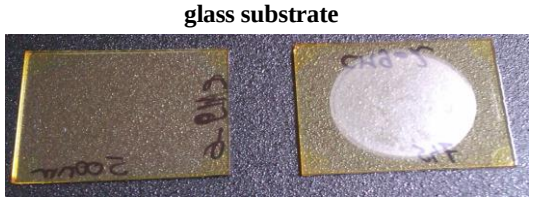
- Romanian Academy Institute of Biology, Bucharest – Dr Norica NICHITA
  - Cell culture tests

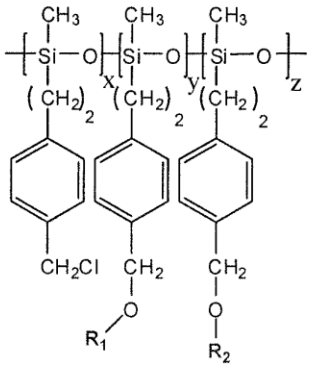
- Commissariat à l'Energie Atomique (CEA) – Dr Licinio ROCHA
  - CW laser nanostructuration
  - Biomolecules nanomanipulation

CELL GROWTH APPLICATIONS

Extracellular Matrix (ECM) Influence

- Adhesion
- Proliferation
- differentiation
- apoptosis (programmed cell death)





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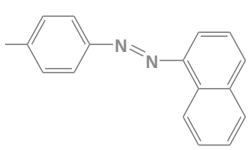

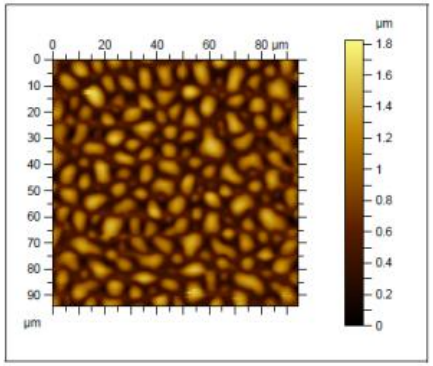

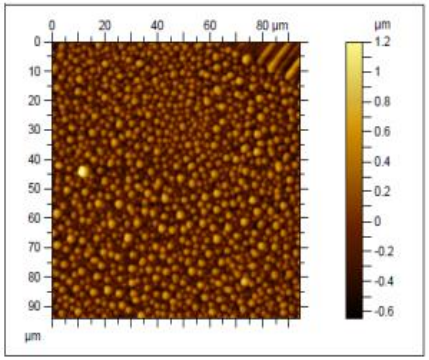

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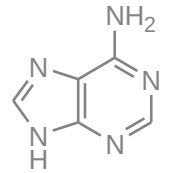

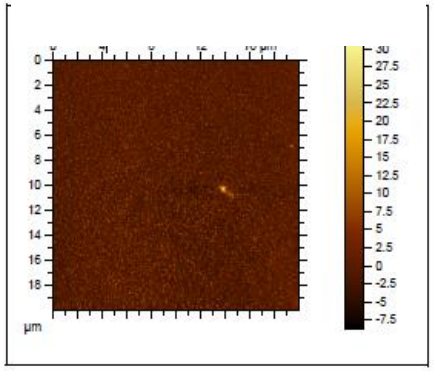

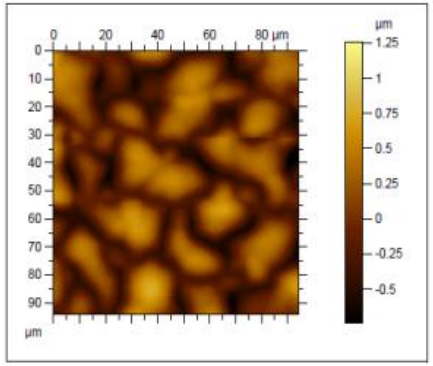

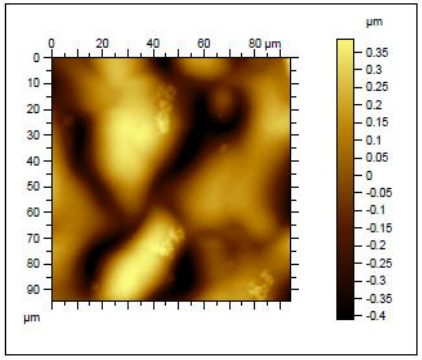

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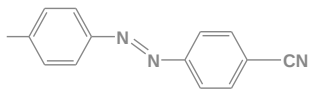

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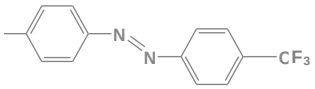
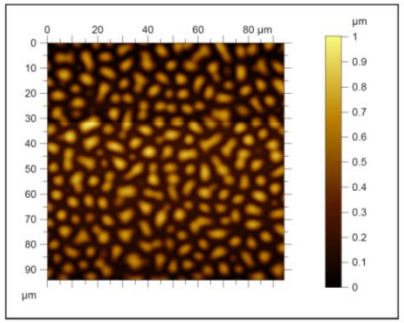
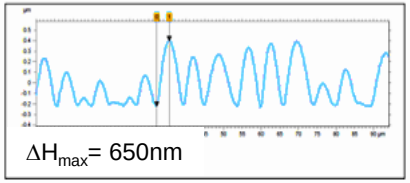


CELL GROWTH APPLICATIONS

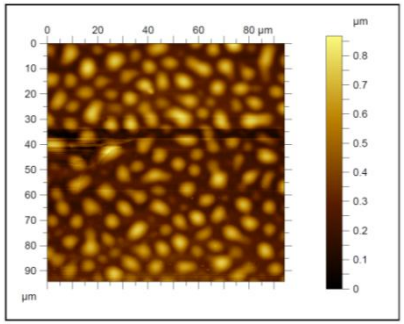
SURFACE TOPOGRAPHY INFLUENCE

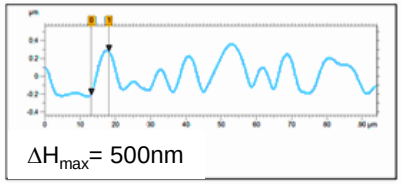
Control surface



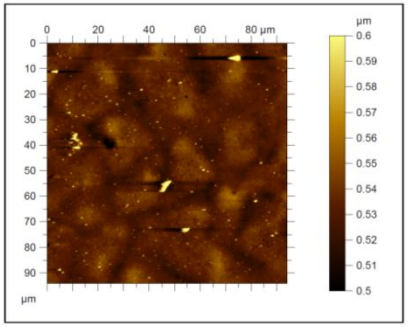


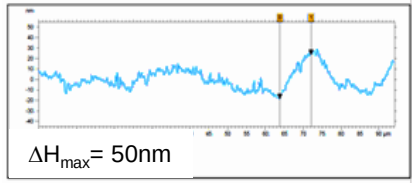
ΔH_{max}= 650nm



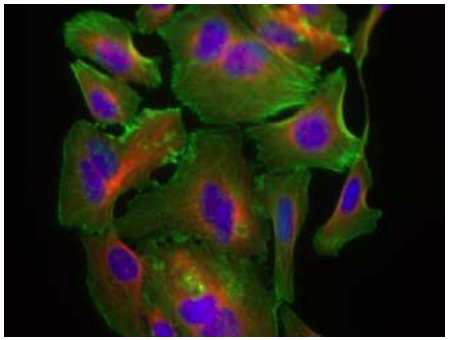


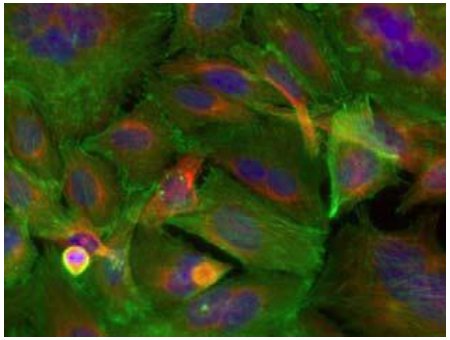
ΔH_{max}= 500nm

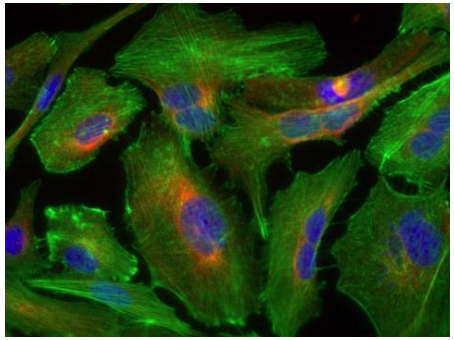


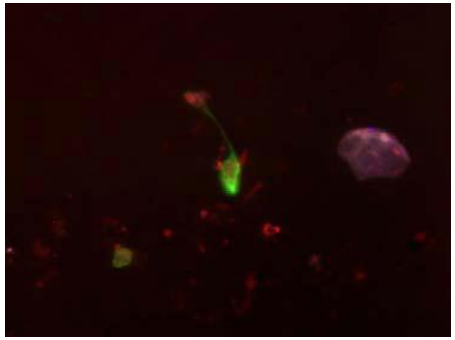


ΔH_{max}= 50nm





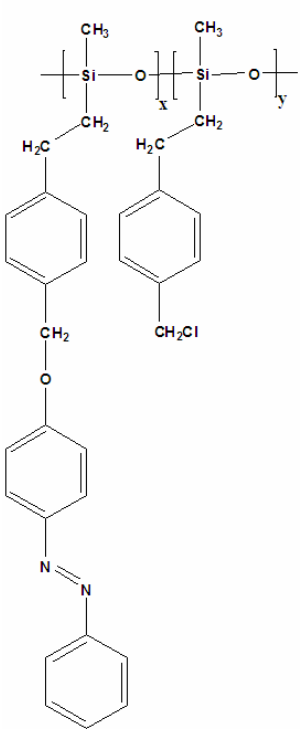


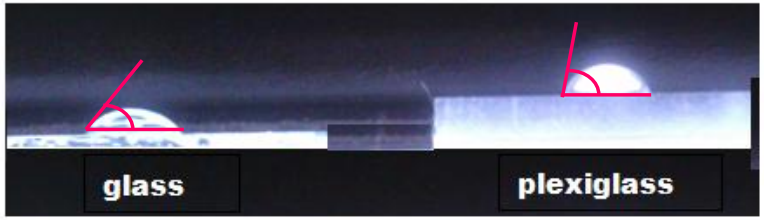


Influence of the film surface:
From increased cells division rates to apoptosis

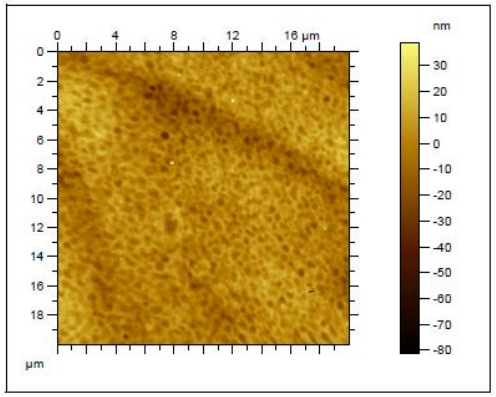
CELL GROWTH APPLICATIONS

SUBSTRATE INDUCED STABILITY

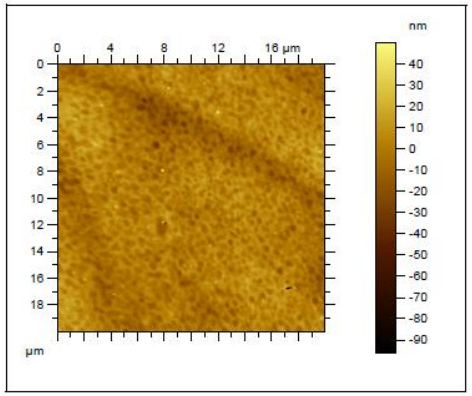




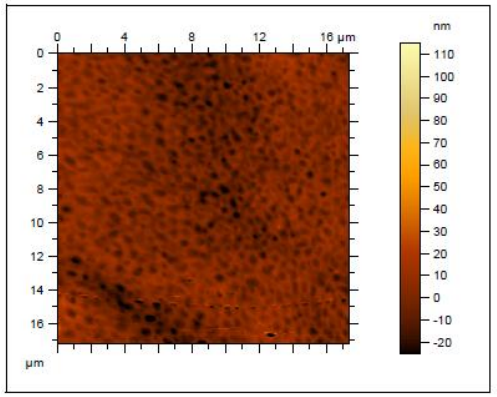
Surface in air



Surface under water 1h

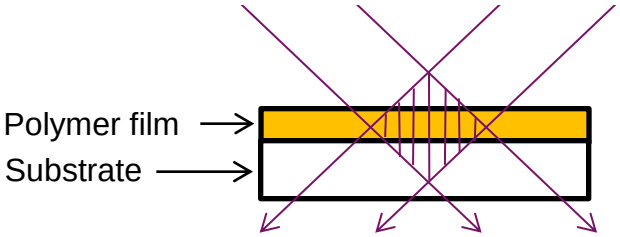


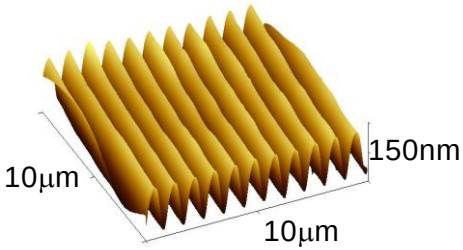
Surface under water 5h

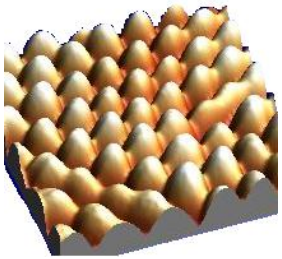


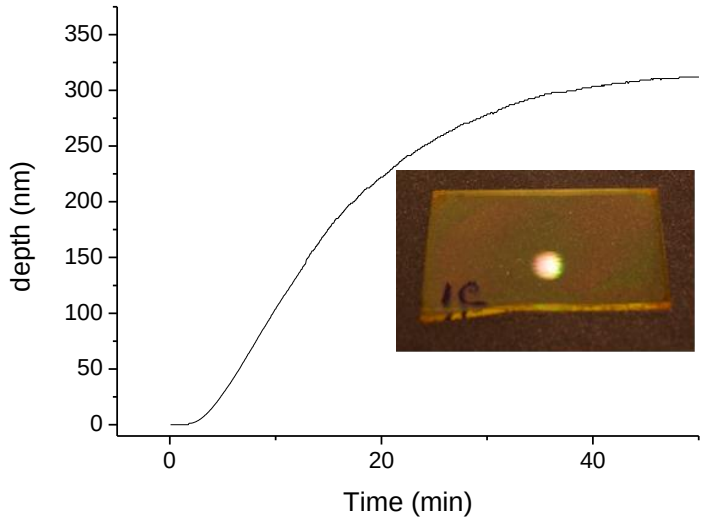
Chemical signal transmitted by the film substrate stabilizing the surface

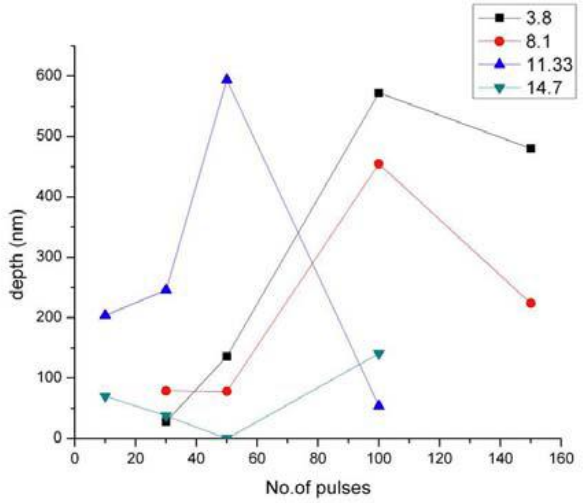
POLYMER FILM SURFACE NANOSTRUCTURATION

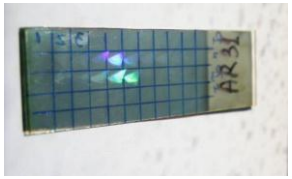








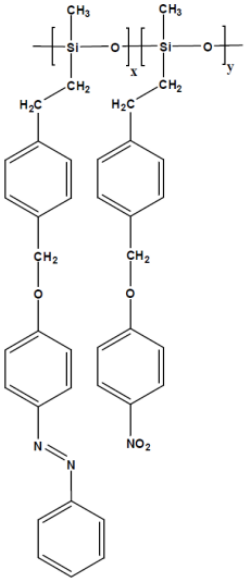


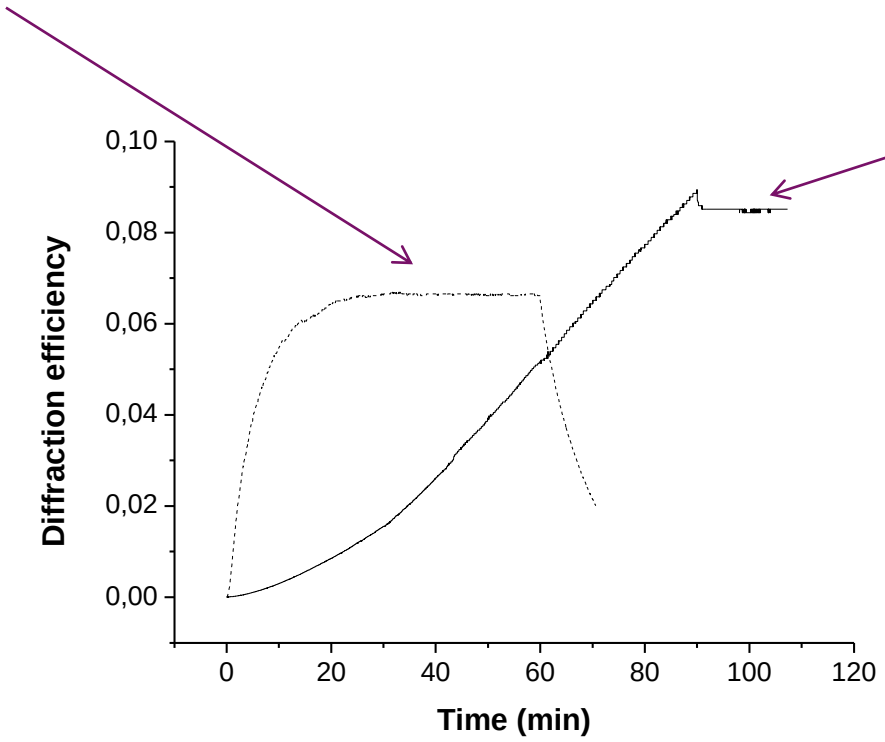


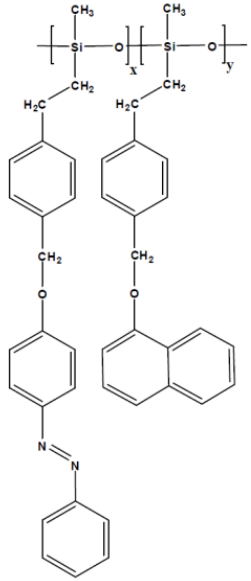
Photoinduced mass transport vs photoinduced molecular reorientation ?

POLYMER FILM SURFACE NANOSTRUCTURATION

INFLUENCE OF THE CHEMICAL STRUCTURE



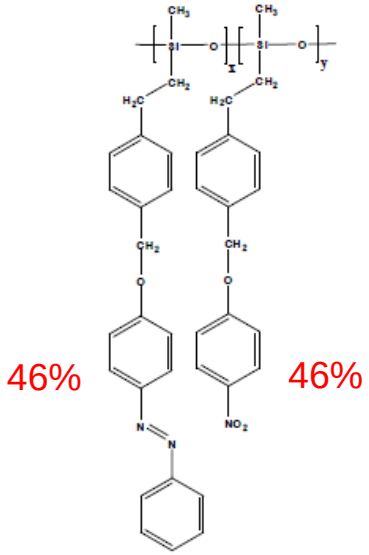




Fine tuning of the mechanical properties
Model materials for mass transport mechanisms comprehension

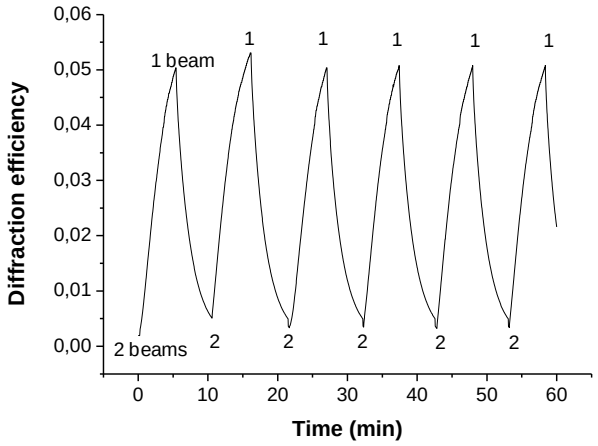
BIOMOLECULES IMMOBILIZATION AND NANOMANIPULATION

STRATEGIES



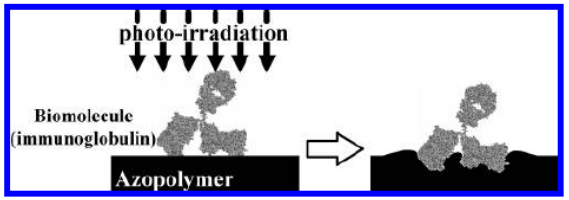
T_g=25°C

46% 46%



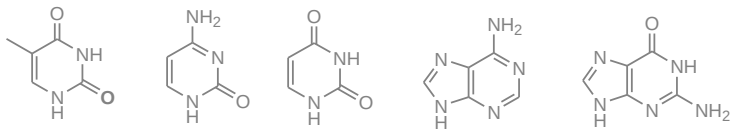
Immobilization

- Optically



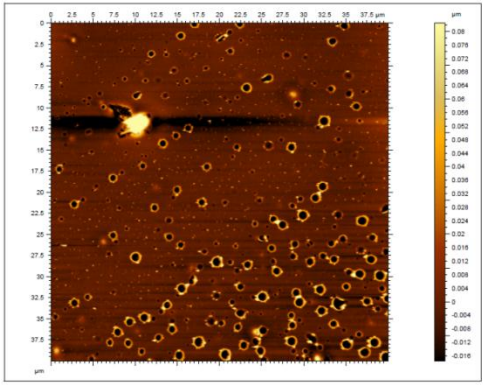
M. Narita *et al.*, *Macromolecules 2007, 40, 623-629*

- Promoting physical interactions between polymer and biomolecules

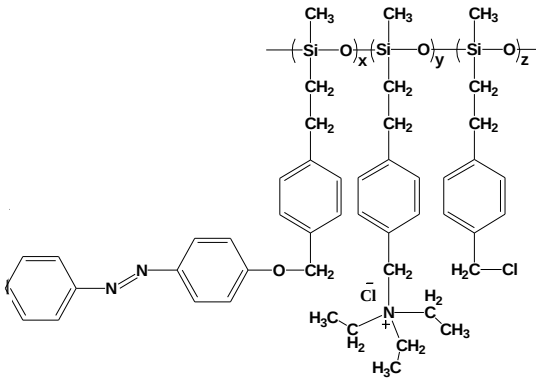


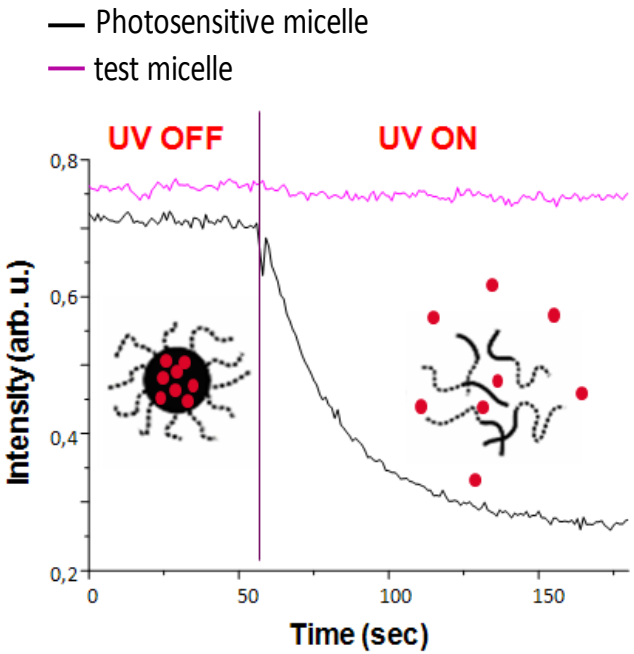
Imaging

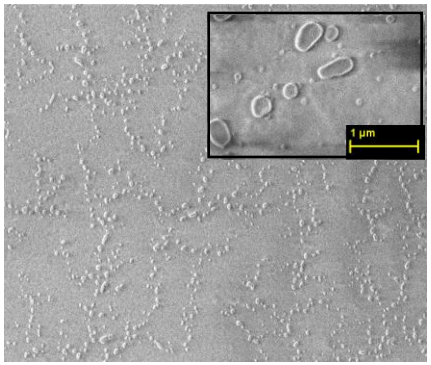
DNA on surface ?

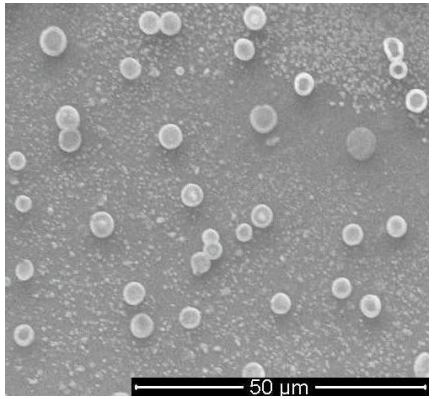


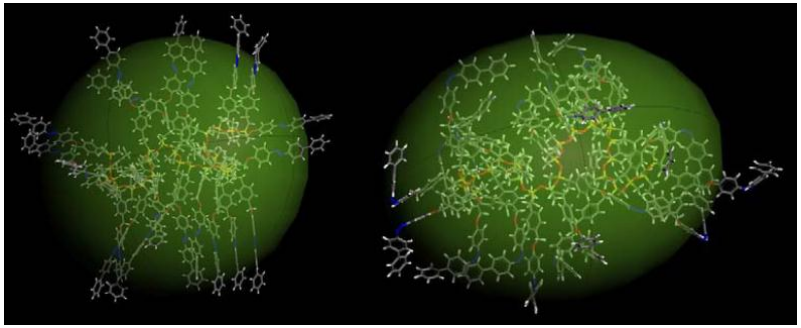
MICELLAR ORGANISATIONS











INPUT

PUBLICATIONS

Rigid and flexible azopolymers modified with donor/acceptor groups. Synthesis and photochromic behaviour.
A. Raicu Luca, L. Rocha, A.-M. Resmerita, A. Macovei, M. Hamel, A.-M. Macsim N. Nichita, N. Hurduc
Express Polymer Letters, **5** (11) 959–969 (2011) DOI: 10.3144/expresspolymlett.2011.94

Amphiphilic azopolymers capable to generate photo-sensitive micelles.
I. Moleavin, C. Ibanescu, A. Hodorog-Rusu, E. Peptu, F. Doroftei, N. Hurduc
Central Eur J Chem – **9** (6), 1117-1125 (2011)

Thermo-sensitive polymers based on graft polysiloxanes
A. D. Rusu, C. Ibanescu, M. Danu, B. C. Simionescu, L. Rocha, N. Hurduc
Polymer Bulletin, 69 579–595 (2012)

Thermal stability study of azo-polysiloxanes with biological applications
Gabriela Lisa, Cristina Paius, Alina Raicu, Nicolae Hurduc
High Performance Polymers - **24** (6) 530-537 (2012)

Nanostructured azo-polysiloxanic films for biological applications.
C.-M. Păiuş, A. Macovei, N. Branza-Nichita, L. Rocha, N. Hurduc
Environmental Engineering and Management Journal - accepted - **Vol.11** (2012)

Thermo-responsiveness of polysiloxanes grafted with poly(dimethyl acrylamide) segments
A. D. Rusu, C. Ibanescu, I. Moleavin, N. Hurduc
Central Eur J Chem **10** (4), 1338-1348 (2012)

Mass transport in low Tg azo-polymers: effect of additional donor/acceptor groups on the surface relief grating induction and stability.
A. Raicu Luca, I. Moleavin, N. Hurduc, L. Rocha
Macromolecular Chemistry and Physics – in preparation

Nano-structured azo-polysiloxanes as new supports for cell cultures.
N. Hurduc, A. Macovei , C. Paius , A. Raicu, I. Moleavin, N. Nichita, L. Rocha
Materials Sci. Eng. C (Materials for Biological Applications) - sent for publication

PATENT

Copolymères d'azo-polysiloxanes photosensibles. Films de ces copolymères, et leur utilisation.
L. Rocha, M. Hamel, I. Moleavin, N. Hurduc, A. Raicu, N. Nichita,
numéro de dépôt 12 54659, date de dépôt 22/05/2012

PROSPECT

Generate a scientific network around « smart » polymers for biological applications.

Scientific exchanges with prof. L. Bouteiller (Université Paris 6) & prof. Harm-Anton Klok (École Polytechnique Fédérale de Lausanne)

Doctoral trainings:
Alina RAICU (3 months in 2010)
Cristina Paius (5 months in 2012)

Post doctoral position:
Ioana MOLEAVIN (2010-2012)
Anca RUSU (from Mai 2012)

Joint supervision thesis starting in October 2012 – Elena RESMERITA

Commissariat à l'énergie atomique et aux énergies alternatives
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Direction **DRT**
Institut **LIST**
Département **DCSI**
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