Department of Growth and Differentiation of Cell Populations

is a member of the Institute of Physiology
& Centre for Cardiovascular Research,
Academy of Sciences of the Czech Republic

Videnska 1083, 142 20 Prague 4-Krc, Czech Republic
Phone: +420 2 9644 2521, 2523, 2572
Fax: +420 2 4106 2488
E-mail: lucy@biomed.cas.cz

Head: Lucie Bacakova, M.D., Ph.D.
Scientists: Assoc. Prof. Vladislav Mares, M.D., D.Sc.
Vera Lisa, M.Sc.
Technician: Ivana Zajanova
PhD students: Elena Filova, M.Sc.
Jaroslav Chlupac, M.D.
Lubica Grausova, M.Sc.
Martin Parizek, M.Sc.
B.A. and M.A. Students: Barbora Vagaska, Milan Smidl, Ivana Koutna

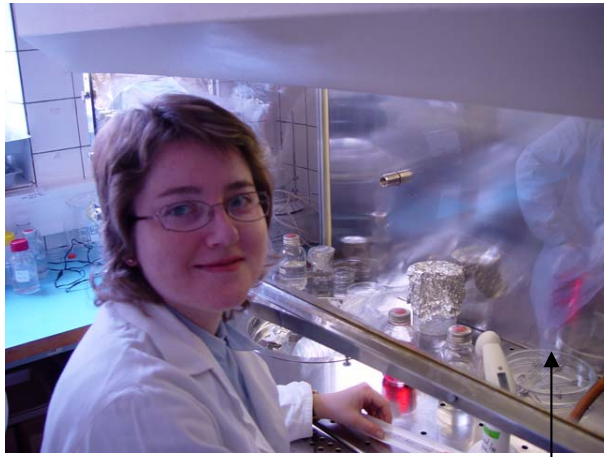

Vladislav Mares
Martin Parizek
Elena Filova
Lucie Bacakova
Vera Lisa
Jaroslav Chlupac


Vera Lisa
Lubica Grausova
Vladislav Mares

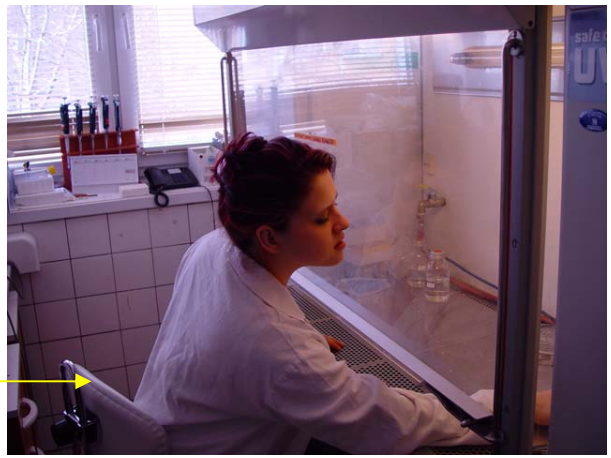

Lubica Grausova


Elena Filova
Ivana Zajanova
Martin Parizek
Vera Lisa
Lucie Bacakova

Laboratory life

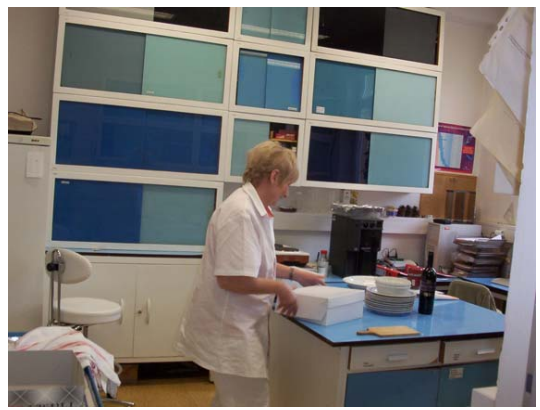


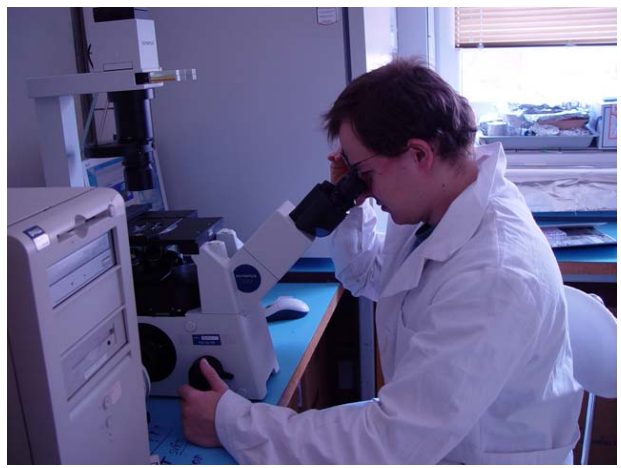
Tissue culture room

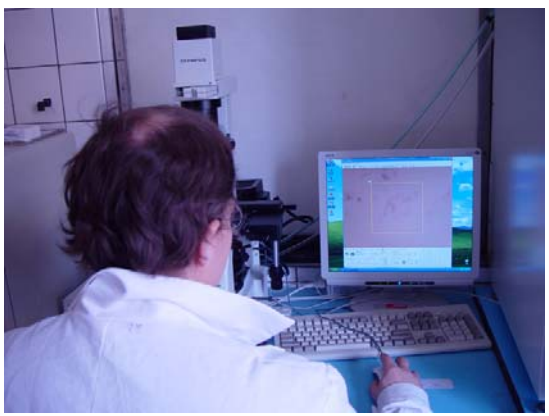


Immunocytochemistry, histology & biochemistry lab

& inverted Olympus fluorescence microscope with digital camera





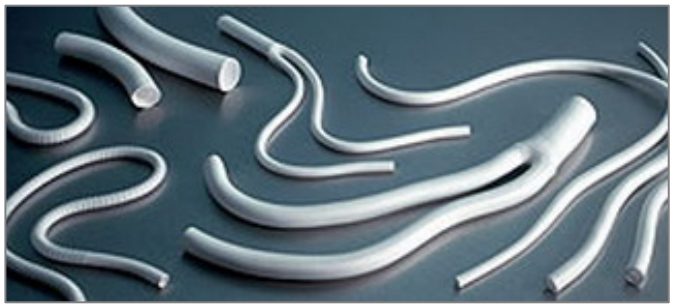


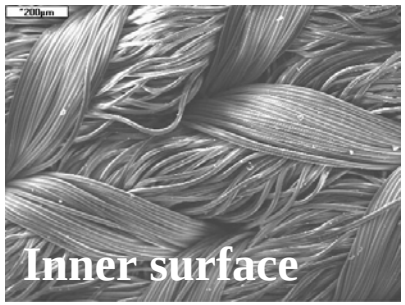
and image analysis

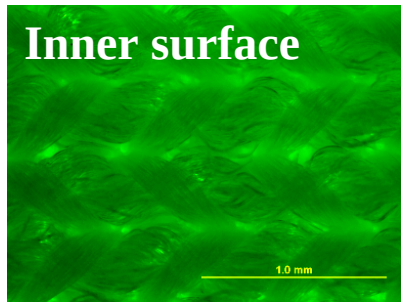
Tissue engineering program

1. Innovation of clinically used vascular prostheses by their endothelialization
2. Construction of bioartificial vascular tissue
3. Regionally-selective cell adhesion on micropatterned surfaces
4. Bone-derived cells on nanostructured materials
5. Bone tissue engineering in three-dimensional scaffolds

1. Innovation of clinically used vascular prostheses: coating with entire extracellular matrix (ECM) molecules and endothelialization





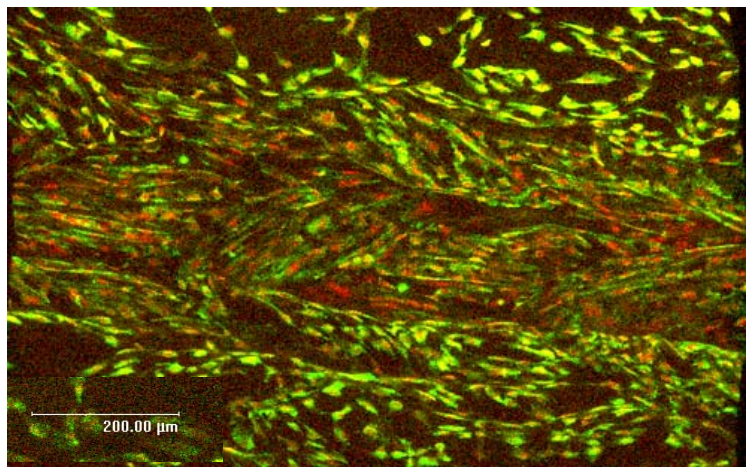


Knitted crimped polyethylene terephtalate (PET) vascular prosthesis, 6 mm ID, impregnated with collagen I, produced in the VÚP® Joint-Stock Comp., Brno, Czech Rep.

On the inner surface, laminin or fibrin were immobilized

The inner surface was then seeded with human saphenous vein endothelial cells (HSVEC) obtained at coronary bypass surgery (1.5 x 10^5 cells / cm^2)

On day 2 after seeding, the cells were exposed to 120 min laminar shear stress (15 dynes/cm^2) in a perfusion system (in cooperation with Inserm U577, Université V. Segalen, Bordeaux, France; Prof. Laurence Bordenave)



Confocal Microscope Leica TCS SP2 AOBS 39 x 10 µm, obj. 10x

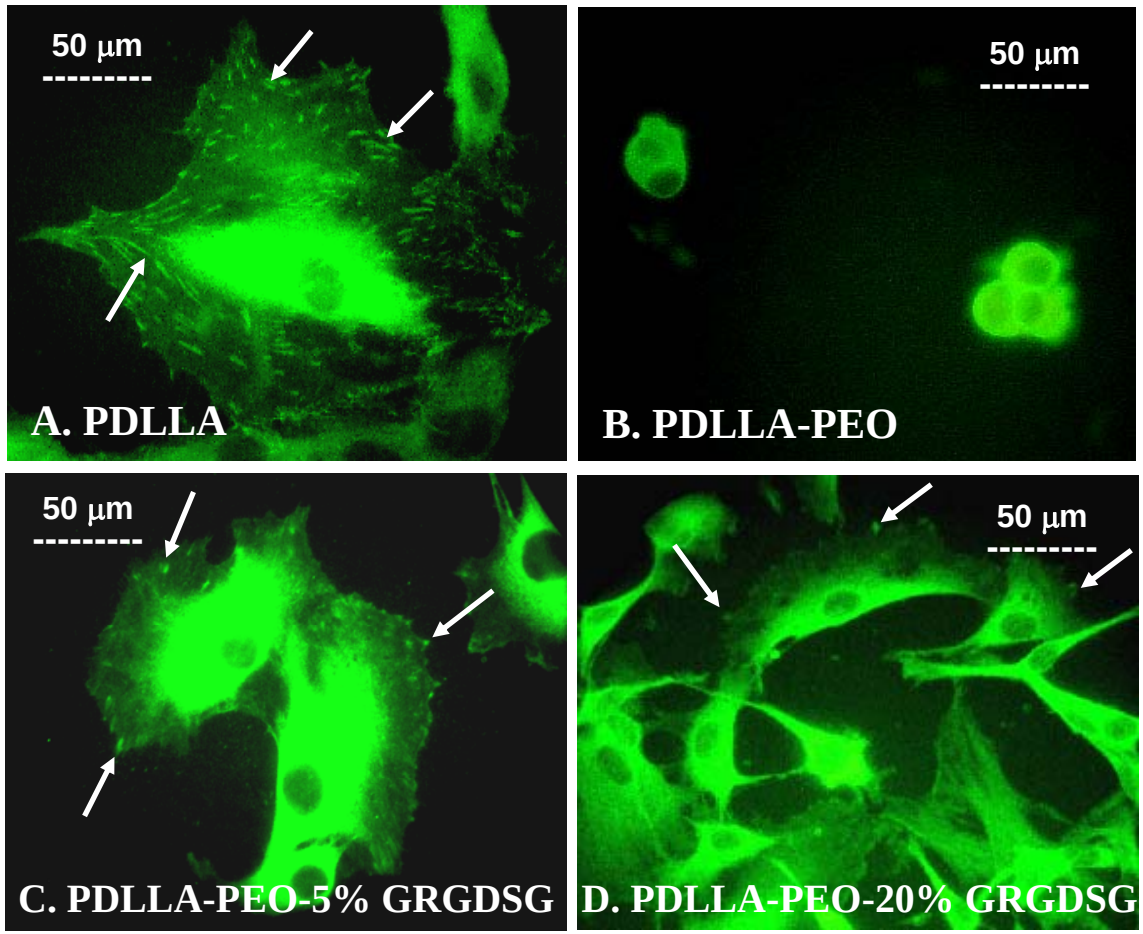
Immunofluorescence staining of **von Willebrand factor**, a marker of endothelial cell identity and differentiation, in HSVEC. The cell nuclei were counterstained with **propidium iodide**.

2. Construction of bioartificial vascular tissue: vascular smooth muscle cells on polymers with ECM-derived ligands for cell adhesion receptors

A. Poly D,L lactide (PDLLA): cell adhesion through proteins adsorbed from the culture medium (vitronectin, fibronectin). Cells are well spread and form vinculin-containing focal adhesion plaques (arrows).

B. Copolymer of PDLLA and polyethylene oxide (PEO): extremely hydrophilic PEO prevents uncontrolled protein adsorption and cell adhesion.

C, D: Functionalization of 5% or 20% of PEO chains with the oligopeptide GRGDSG, a ligand for integrin adhesion receptors, restored (at least partly) the cell adhesion, spreading and assembly of focal adhesion plaques (arrows).



Imunofluorescence staining of vinculin, a protein of focal adhesion plaques, day 3 after seeding.

Polymeric materials prepared in the Institute of Macromolecular Chemistry, Acad. Sci. CR

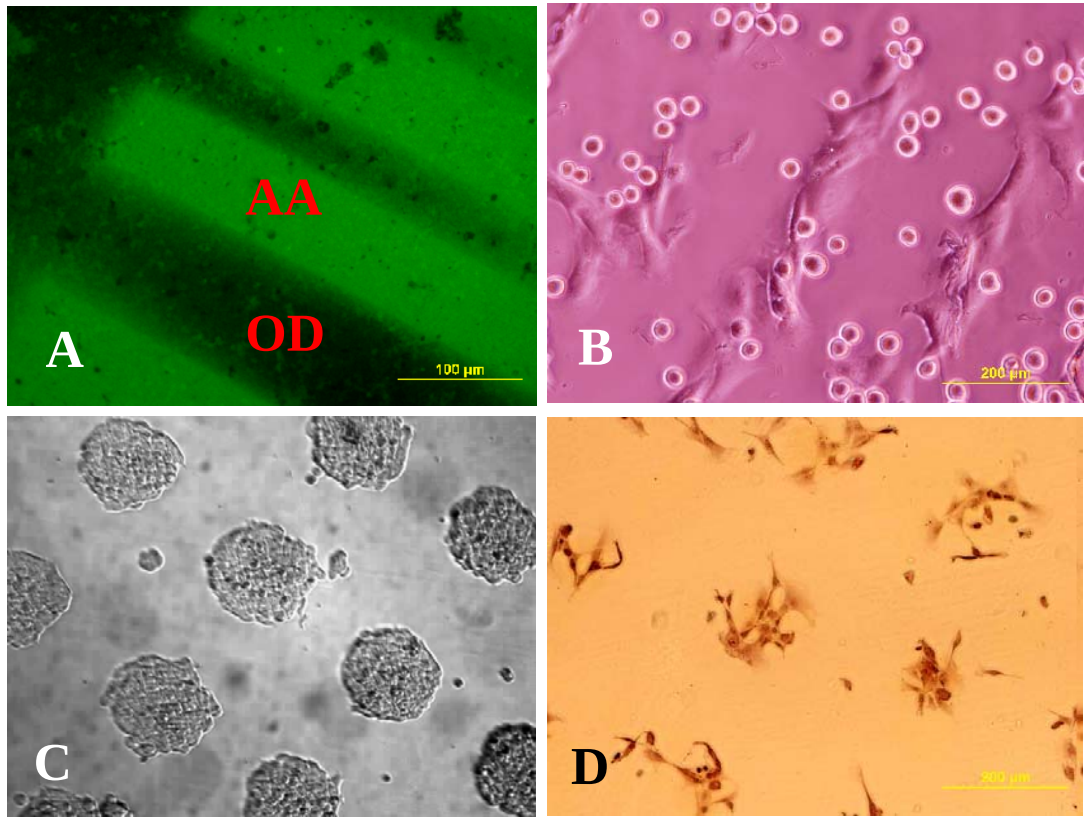
3. Regionally-selective cell adhesion on micropatterned surfaces

A, B. Microstructured surfaces created by plasma polymerisation of hydrophilic acrylic acid (AA) and hydrophobic 1,7- octadiene (OD).
A. Preferential adsorption of fluorescence-labelled collagen IV on AA domains.

B. Preferential adhesion of vascular smooth muscle cells on AA domains.

C. Preferential adhesion of vascular endothelial cells on microdomains created by UV-light irradiation of polytetrafluoroethylene through a metallic mask in NH_3 atmosphere.

D. Preferential adhesion of vascular smooth muscle cells on microdomains created by the irradiation of polyethylene with Ar^+ ions (energy 150 keV, dose 10^{13} ions/cm^2).



Micropatterned surfaces are useful for obtaining regionally-selective cell adhesion on materials for tissue engineering or in microarray technique for advanced research in genomics and proteomics.

Materials were prepared in the cooperation with the Department of Engineering Materials, University of Sheffield, Sheffield, UK (A, B), Angewandte Physik, Johannes Kepler Universität, Linz, Austria (C) and the Institute of Chemical Technology, Prague, Czech Rep. (D)

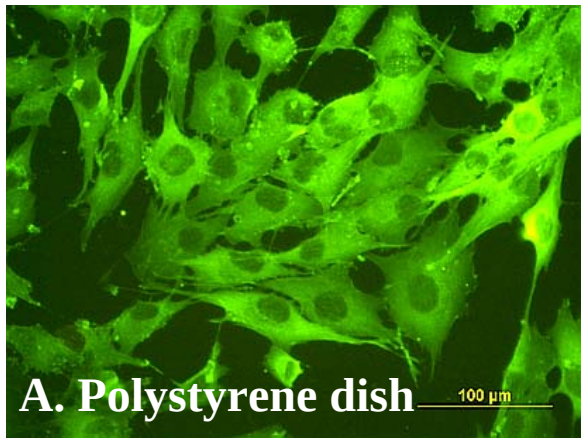
4. Human osteoblast-like MG 63 cells on nanostructured materials

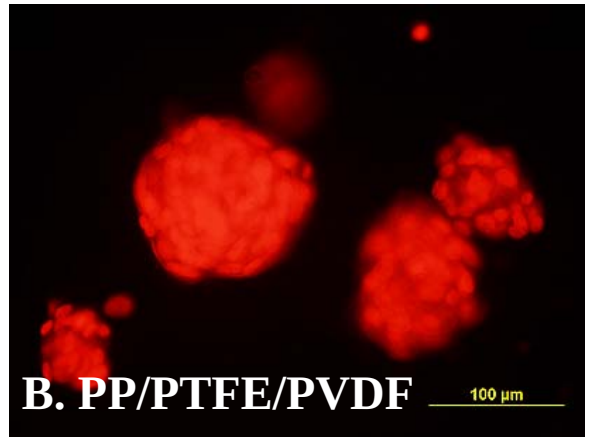
A. Well spread MG 63 cells on standard tissue culture polystyrene.

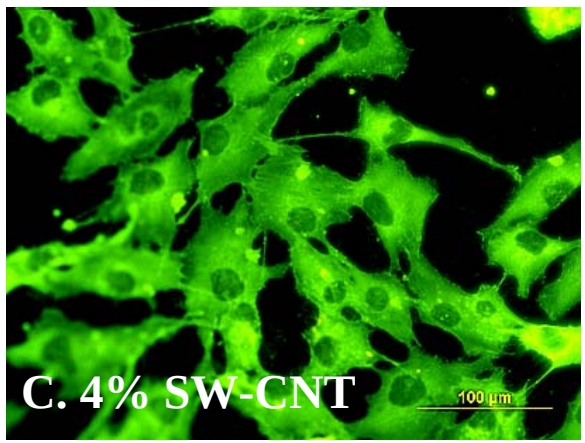
B. Round, non-spread and aggregated cells on highly hydrophobic terpolymer of polypropylene, polytetrafluorethylene and polyvinyldifluoride.

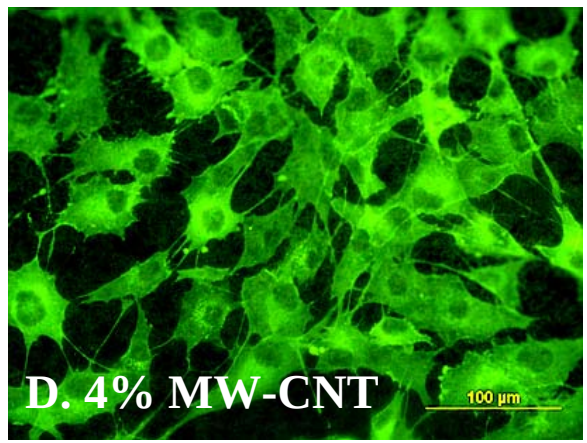
C, D. The cell adhesion and spreading was restored when the nanostructure of the material surface was created by mixing single- or multi-walled carbon nanotubes with the terpolymer.

Materials were prepared in cooperation with the AGH University of Science and Technology, Krakow, Poland



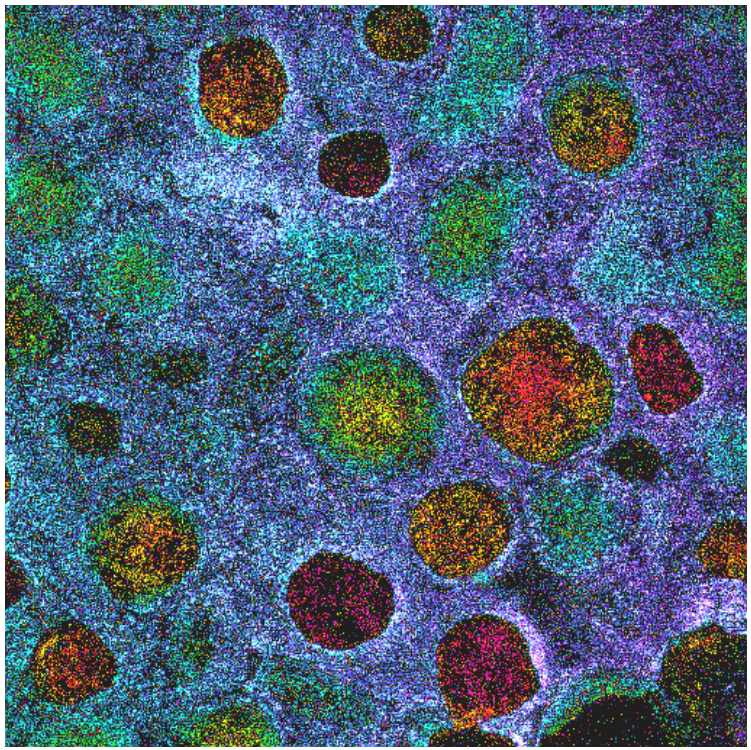






Immunofluorescence of beta-actin cytoskeleton (A, C, D) or **propidium iodide staining** of cell nuclei and partially cell cytoplasm (B), day 3 after seeding, microscope Olympus IX 50, digital camera DP 70, obj. 20x

5. Human osteoblast-like MG 63 cells in “three-dimensional“ porous scaffolds for bone tissue engineering



Cells in depth of:

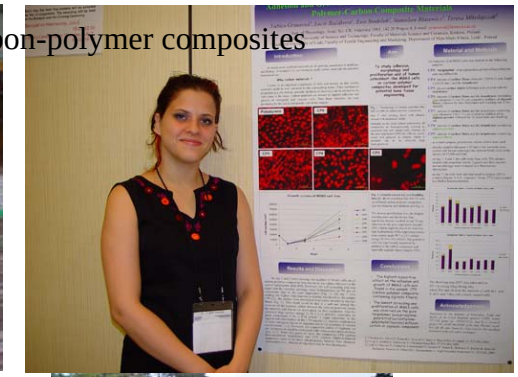
0 – 60 μm (blue signal)
80 – 160 μm (green)
180 – 220 μm (yellow)
240 – 300 μm (orange)
320 – 400 μm (red)
420 – 480 μm (violet)

- Scaffolds were made of a copolymer of lactide and glycolide
- Collaboration with the AGH University of Science and Technology, Faculty of Materials Science and Ceramics, Krakow, Poland
- Average pore size and depth was about 400 μm
- Seeded with ~ 70 000 cells/cm^2, cultured in the medium DMEM with 10% of fetal bovine serum for 14 days
- Cells fixed with ethanol, stained with propidium iodide
- Examined in confocal microscope (Leica TCS SP2, Germany) using transversal optical sections through pores every 20 μm

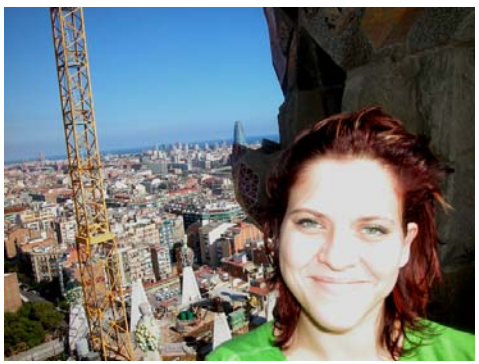
Carbon 2005

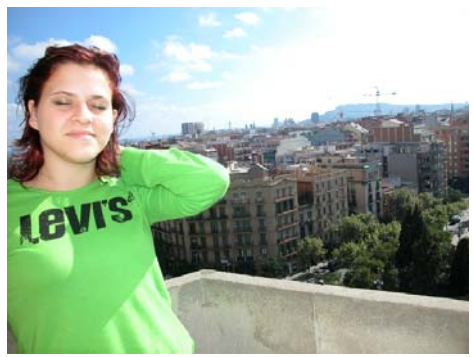
International Conference on Carbon, July 3-7, Gyeongju, Korea

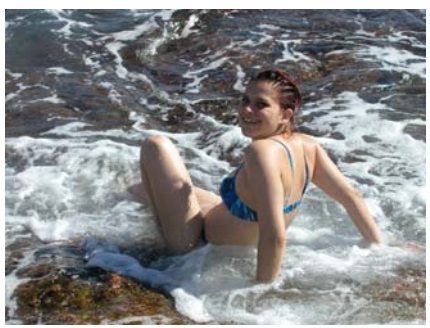

Lecture on bone cells on a fullerene layer

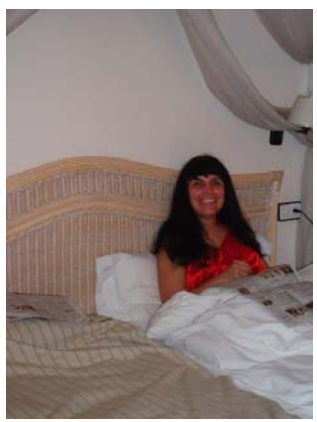

Poster on carbon-polymer composites

Plasma Polymers and Related Materials,
Joint Meeting of the COST, Workgroup 527,
Sant Feliu de Guixols near Barcelona, Spain; October 2005



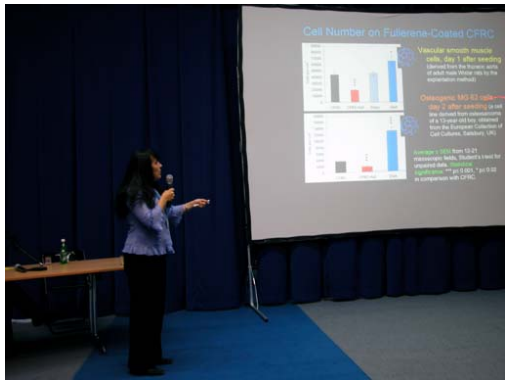






XV Conference on Biomaterials in Medicine and Veterinary Medicine

Rytro, Poland, October 13-16, 2005







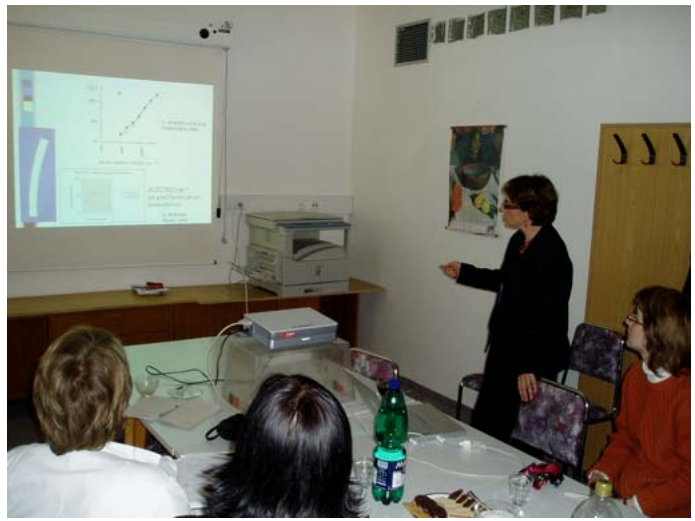






Visit of French scientists in our lab, November 2005

Université Victor Segalen, l'Unité INSERM 577, Laboratoire de Biophysique, Bordeaux, France; collaboration within **Barrande project**



Prof. Laurence Bordenave giving a lecture on vascular biology & tissue engineering

Confocal microscopy of bioartificial vascular prostheses

Visit of Polish scientists in our lab, February 2006

AGH University of Science and Technology, Faculty of Materials Science and Ceramics, Dept. of Biomaterials, Krakow, Poland

Collaboration on bone tissue engineering (bone cells on polymeric and carbon materials, including those three-dimensional and nanostructured)

Join our vascular and bone tissue engineering team!