Scientific Report stage 2/05.12.2012

General Objectives: Having a platform to stimulate cell growth and guidance for tissue regeneration is essential in various biomedical applications and in tissue engineering, and involves the need to obtain two and three-dimensional structures, specifically localized micro-and nano-textured surfaces of hybrid or composite materials. This project is mainly aimed at obtaining hybrid micro and nano complex structured polymer supports used as platforms for oriented cell growth by using laser based methods (matrix assisted laser evaporation-MAPLE, Laser Induced Forward Transfer - and laser direct irradiation / material processing).
A complementary direction followed in this project is to evaluate the effect of texturing and layout of two and three-dimensional "architecture" type on cells adhesion, growth, inhibition and on other cellular interactions in vitro.

Execution phase objectives:

In this phase, according to the Gantt chart, the corresponding activities work package WP2 were completed in parallel are started activities in work packages WP3, WP5 respectively and dissemination activities included in WP6. The main objectives at this stage related to each work package are listed below:

WP2-Obtaining biocompatible polymer thin films, antimicrobial and degraded by MAPLE and spin coating
WP3- Obtaining controlled microstructures (ditches / canals, craters) by laser irradiation
WP5-Testing of thin films and microstructures obtained in vitro,
WP6-Dissemination and reporting project phase.

Summary Phase: In this phase the optimization of the parameters to obtain organic layers as thin films by MAPLE and spin coating (WP2) was obtained. The preliminary parameters on modifying the surface architecture and physicochemical properties by direct irradiation with a fs laser beam (WP3) established . Also, , in vitro tests were performed in parallel, in which fibroblast cell morphology and viability was analyzed and correlated to the obtained films and structures (WP5).

Results:
This research phase reached its objectives entirely, so the following results were obtained:
1 Thin films were obtained as a monolayer by using MAPLE and spin-coating (PEG, chitosan, collagen and chitosan or collagen incorporated PEG)
2. Preliminary tests were conducted to modify the surface architecture and the physicochemical properties direct irradiation with a laser beam;
3. The thin films and structures were characterized morphologically and structurally by atomic force microscopy – AFM, scanning electron microscopy, SEM, spectroelipsometry - SE, and Fourier spectroscopy- FTIR);

4. Parameters for obtaining thin films (single, multi) by MAPLE and spin-coating each material in part have been optimized after correlating the physical and chemical parameters deposit / obtaining thin layers;
5. MAPLE technique is preferred for control of multilayer structures, especially when it is necessary to use the same solvent (for example acetic acid solution to chitosan and collagen, and toluene, chloroform or PEG, PEO, PCL);
6. Preliminary tests were conducted in vitro, indicating that the initial spreading of fibroblast cell is conditionated by the morphology of the polymeric substrate.
7 Our observations in vitro experiments show that the films obtained by MAPLE and spin coating have good stability in aqueous medium, while for the reference, obtained by evaporation of the solvent, a detachment from the surface on which they were deposited occurs after a testing time of 2 days.
8. Dissemination activities were conducted which consisted of invited presentations, oral presentations, 2 articles and seven posters sustained by 4 of the project participants.

Articles:
1. L.Rusen, C.Mustaciosu, B.Mitu, M.Filipescu, M.Dinescu, V.Dinca
Protein-Resistant Polymer Coatings obtained by Matrix Assisted Pulsed Laser Evaporation
Applied Surface Science DOI: 10.1016/j.apsusc.2013.01.109
Volume 278, 1 August 2013, Pages 198-202.

2. V.Dinca, T.Mattle, A.Palla-Papavlu, L.Rusen, C.Luculescu, T.Lippert, M.Dinescu
Polyethyleneimine patterns obtained by laser-transfer assisted by a Dynamic Release Layer onto Themanox soft substrates for cell adhesion study
Applied Surface Science DOI: 10.1016/j.apsusc.2013.02.052
Volume 278, 1 August 2013, Pages 190-197.

Presentations:

MAPLE and LIFT “soft” laser techniques for organic materials processing, V. Dinca, A. Matei, A. Palla Papavlu and M. Dinescu , Curent trends and advanced ellipsometry and all x-ray techniques for the characterization of TCO, BIO and other nanostructured materials” workshop, 12-14 Sept, 2012, Bucharest Romania, invited.

Laser induced forward transfer (LIFT) for biomedical applications, V. Dinca, A. Palla Papavlu, M. Dinescu, Emerging Analytical Tools to Investigate Nitro-Oxidative Stress” - Exploratory Workshop, July 24-26 2012, Bucharest Romania, invited

Posters:

1.L.Rusen, M. Zamfirescu, C. Luculescu and V. Dinca
Changes on the Surface of Polymer Films Induced by Femtosecond Laser Irradiation
International Student Conference on Photonics - ISCP 2012, 8-12 May, Sinaia, Romania - ISCP2012

2.L. Rusen, V. Dinca, C. Mustaciosu, C. Luculescu, M. Zamfirescu, M. Filipescu, M. Dinescu
Morphological characteristics of chitosan based structures obtained by nanosecond and femtosecond laser methods
European Materials Research Society EMRS2012, 14-18 May, Strasbourg - EMRS2012

3.Dinca V., Rusen L., A. Palla Papavlu, A. Matei, V. Ion and M. Dinescu
Polymer Multilayer obtained by Matrix Assisted Pulsed Laser Alternative Evaporation
European Materials Research Society EMRS2012, 14-18 May, Strasbourg - EMRS2012

4.V. Dinca, C. Mustaciosu, A. Palla-Papavlu, L. Rusen, B. Mitu, M. Filipescu , M. Dinescu
Protein-Resistant Polymer Coatings obtained by Matrix Assisted Pulsed Laser Evaporation
European Materials Research Society EMRS2012, 14-18 May, Strasbourg - EMRS2012

5. L. Rusen, V. Dinca, C. Mustaciosu, M. Zamfirescu M. Dinescu
Effective method for polymeric materials patterning for cell behavior studies
Micro - to Nano-Photonics III - ROMOPTO 2012, Bucharest, 3 - 6 September, Romania - ROMOPTO2012

6. V. Dinca, L. Rusen, M. Dinescu
Matrix Assisted Pulsed Laser Evaporation of biopolymers using 266 nm for biomedical applications
Micro - to Nano-Photonics III - ROMOPTO 2012, Bucharest, 3 - 6 September, Romania - ROMOPTO2012

7. V. Dinca, T. Mattle A. Palla Papavlu, M. Filipescu, M. Dinescu,
A. Wokaun, T. Lippert
Polymer micro and nanopatterning using laser transfer onto soft substrates assisted by a dynamic release layer, EMRS 2012, Strasbourg, Franta